Emergence Of Life On Earth A Historical And Scientific Overview

This book sets forth a set of truly controversial and astonishing theories: First, it proposes that below the surface of the earth is a biosphere of greater mass and volume than the biosphere the total sum of living things on our planet's continents and in its oceans. Second, it proposes that the inhabitants of this subterranean biosphere are not plants or animals as we know them, but heat-loving bacteria that survive on a diet consisting solely of hydrocarbons that is, natural gas and petroleum. And third and perhaps most heretically, the book advances the stunning idea that most hydrocarbons on Earth are not the byproduct of biological debris ("fossil fuels"), but were a common constituent of the materials from which the earth itself was formed some 4.5 billion years ago. The implications are astounding. The theory proposes answers to often-asked questions: Is the deep hot biosphere where life originated, and do Mars and other seemingly barren planets contain deep biospheres? Even more provocatively, is it possible that there is an enormous store of hydrocarbons upwelling from deep within the earth that can provide us with abundant supplies of gas and petroleum? However far-fetched these ideas seem, they are supported by a growing body of evidence, and by the indisputable stature and seriousness Gold brings to any scientific debate. In this book we see a brilliant and boldly original thinker, increasingly a rarity in modern
science, as he develops potentially revolutionary ideas about how our world works. "Essential reading for people in disciplines ranging from philosophy to biology. It is simply the best general book that I know on the question of the origin of life." --Michael Ruse, author of Mystery of Mysteries: Is Evolution a Social Construction? "Fry has fashioned a masterful account of the history, philosophy, and science of the origin of life and the possibility of extraterrestrial life. Her story weaves profound Western ideas of who we are and where we came from, from Aristotle to Gould, from Kant to NASA." --Woodruff Sullivan, University of Washington "A rich source for the specialist and thought-provoking reading for the lay person." Gunter Wachtershauser, University of Regensburg, Germany

How did life emerge on Earth? Is there life on other worlds? These questions, until recently confined to the pages of speculative essays and tabloid headlines, are now the subject of legitimate scientific research. This book presents a unique perspective--a combined historical, scientific, and philosophical analysis, which does justice to the complex nature of the subject. The book's first part offers an overview of the main ideas on the origin of life as they developed from antiquity until the twentieth century. The second, more detailed part of the book examines contemporary theories and major debates within the origin-of-life scientific community. Topics include:

- Aristotle and the Greek atomists' conceptions of the organism
- Alexander Oparin and J.B.S. Haldane's 1920s breakthrough papers
- Possible life on Mars?

Why is life the way it is? Bacteria evolved into complex life just once in four billion years
of life on earth-and all complex life shares many strange properties, from sex to ageing and death. If life evolved on other planets, would it be the same or completely different? In The Vital Question, Nick Lane radically reframes evolutionary history, putting forward a cogent solution to conundrums that have troubled scientists for decades. The answer, he argues, lies in energy: how all life on Earth lives off a voltage with the strength of a bolt of lightning. In unravelling these scientific enigmas, making sense of life's quirks, Lane's explanation provides a solution to life's vital questions: why are we as we are, and why are we here at all? This is ground-breaking science in an accessible form, in the tradition of Charles Darwin's The Origin of Species, Richard Dawkins' The Selfish Gene, and Jared Diamond's Guns, Germs and Steel.

Publisher Description
How did life start? Is the evolution of life describable by any physics-like laws? Stuart Kauffman's latest book offers an explanation—beyond what the laws of physics can explain—of the progression from a complex chemical environment to molecular reproduction, metabolism and to early protocells, and further evolution to what we recognize as life. Among the estimated one hundred billion solar systems in the known universe, evolving life is surely abundant. That evolution is a process of "becoming" in each case. Since Newton, we have turned to physics to assess reality. But physics alone cannot tell us where we came from, how we arrived, and why our world has evolved past the point of unicellular organisms to an extremely complex biosphere.
Building on concepts from his work as a complex systems researcher at the Santa Fe Institute, Kauffman focuses in particular on the idea of cells constructing themselves and introduces concepts such as "constraint closure." Living systems are defined by the concept of "organization" which has not been focused on in enough in previous works. Cells are autopoetic systems that build themselves: they literally construct their own constraints on the release of energy into a few degrees of freedom that constitutes the very thermodynamic work by which they build their own self creating constraints. Living cells are "machines" that construct and assemble their own working parts. The emergence of such systems—the origin of life problem—was probably a spontaneous phase transition to self-reproduction in complex enough prebiotic systems. The resulting protocells were capable of Darwin's heritable variation, hence open-ended evolution by natural selection. Evolution propagates this burgeoning organization. Evolving living creatures, by existing, create new niches into which yet further new creatures can emerge. If life is abundant in the universe, this self-constructing, propagating, exploding diversity takes us beyond physics to biospheres everywhere. This classic of biochemistry offered the first detailed exposition of the theory that living tissue was preceded upon Earth by a long and gradual evolution of nitrogen and carbon compounds. "Easily the most scholarly authority on the question...it will be a landmark for discussion for a long time to come." — New York Times.
A major scientific revolution has begun, a new paradigm that rivals Darwin's theory in importance. At its heart is the discovery of the order that lies deep within the most complex of systems, from the origin of life, to the workings of giant corporations, to the rise and fall of great civilizations. And more than anyone else, this revolution is the work of one man, Stuart Kauffman, a MacArthur Fellow and visionary pioneer of the new science of complexity. Now, in At Home in the Universe, Kauffman brilliantly weaves together the excitement of intellectual discovery and a fertile mix of insights to give the general reader a fascinating look at this new science--and at the forces for order that lie at the edge of chaos. We all know of instances of spontaneous order in nature--an oil droplet in water forms a sphere, snowflakes have a six-fold symmetry. What we are only now discovering, Kauffman says, is that the range of spontaneous order is enormously greater than we had supposed. Indeed, self-organization is a great undiscovered principle of nature. But how does this spontaneous order arise? Kauffman contends that complexity itself triggers self-organization, or what he calls "order for free," that if enough different molecules pass a certain threshold of complexity, they begin to self-organize into a new entity--a living cell. Kauffman uses the analogy of a thousand buttons on a rug--join two buttons randomly with thread, then another two, and so on. At first, you have isolated pairs; later, small clusters; but suddenly at around the 500th repetition, a remarkable transformation occurs--much like the phase transition
when water abruptly turns to ice—and the buttons link up in one giant network. Likewise, life may have originated when the mix of different molecules in the primordial soup passed a certain level of complexity and self-organized into living entities (if so, then life is not a highly improbable chance event, but almost inevitable). Kauffman uses the basic insight of "order for free" to illuminate a staggering range of phenomena. We see how a single-celled embryo can grow to a highly complex organism with over two hundred different cell types. We learn how the science of complexity extends Darwin's theory of evolution by natural selection: that self-organization, selection, and chance are the engines of the biosphere. And we gain insights into biotechnology, the stunning magic of the new frontier of genetic engineering—generating trillions of novel molecules to find new drugs, vaccines, enzymes, biosensors, and more. Indeed, Kauffman shows that ecosystems, economic systems, and even cultural systems may all evolve according to similar general laws, that tissues and terra cotta evolve in similar ways. And finally, there is a profoundly spiritual element to Kauffman's thought. If, as he argues, life were bound to arise, not as an incalculably improbable accident, but as an expected fulfillment of the natural order, then we truly are at home in the universe. Kauffman's earlier volume, The Origins of Order, written for specialists, received lavish praise. Stephen Jay Gould called it "a landmark and a classic." And Nobel Laureate Philip Anderson wrote that "there are few people in this world who ever ask the right questions of science, and they are the ones who affect its future most profoundly."
Stuart Kauffman is one of these." In At Home in the Universe, this visionary thinker takes you along as he explores new insights into the nature of life. The origin of life from inanimate matter has been the focus of much research for decades, both experimentally and philosophically. Luisi takes the reader through the consecutive stages from prebiotic chemistry to synthetic biology, uniquely combining both approaches. This book presents a systematic course discussing the successive stages of self-organisation, emergence, self-replication, autopoiesis, synthetic compartments and construction of cellular models, in order to demonstrate the spontaneous increase in complexity from inanimate matter to the first cellular life forms. A chapter is dedicated to each of these steps, using a number of synthetic and biological examples. With end-of-chapter review questions to aid reader comprehension, this book will appeal to graduate students and academics researching the origin of life and related areas such as evolutionary biology, biochemistry, molecular biology, biophysics and natural sciences. What determines whether complex life will arise on a planet, or even any life at all? Questions such as these are investigated in this groundbreaking book. In doing so, the authors synthesize information from astronomy, biology, and paleontology, and apply it to what we know about the rise of life on Earth and to what could possibly happen elsewhere in the universe. Everyone who has been thrilled by the recent discoveries of extrasolar planets and the indications of life on Mars and the Jovian moon Europa will
be fascinated by Rare Earth, and its implications for those who look to the heavens for companionship.

The rhythm of life on Earth includes several strong themes contributed by Kingdom Fungi. So why are fungi ignored when theorists ponder the origin of life? Casting aside common theories that life originated in an oceanic primeval soup, in a deep, hot place, or even a warm little pond, this is a mycological perspective on the emergence of life on Earth. The author traces the crucial role played by the first biofilms – products of aerosols, storms, volcanic plumes and rainout from a turbulent atmosphere – which formed in volcanic caves 4 billion years ago. Moore describes how these biofilms contributed to the formation of the first prokaryotic cells, and later, unicellular stem eukaryotes, highlighting the role of the fungal grade of organisation in the evolution of higher organisms. Based on the latest research, this is a unique account of the origin of life and its evolutionary diversity to the present day.

This volume is the edited proceedings of a conference seeking to clarify the possible role of clays in the origin of life on Earth. At the heart of the problem of the origin of life lie fundamental questions such as: What kind of properties is a model of a primitive living system required to exhibit and what would its most plausible chemical and molecular makeup be? Answers to these questions have traditionally been sought in terms of properties that are held to be common to all contemporary organisms. However, there are a number of different ideas both on the nature and on the
evolutionary priority of 'common vital properties', notably those based on protoplasmic, biochemical and genetic theories of life. This is therefore the first area for consideration in this volume and the contributors then examine to what extent the properties of clay match those required by the substance which acted as the template for life. "The rhythm of life on Earth includes several strong themes contributed by Kingdom Fungi. So why are fungi ignored when theorists ponder the origin of life? Casting aside common theories that life originated in an oceanic primeval soup, in a deep, hot place, or even a warm little pond, this is a mycological perspective on the emergence of life on Earth. The author traces the crucial role played by the first biofilms - products of aerosols, storms, volcanic plumes and rainout from a turbulent atmosphere - which formed in volcanic caves 4 billion years ago. Moore describes how these biofilms contributed to the formation of the first prokaryotic cells, and later, unicellular stem eukaryotes, highlighting the role of the fungal grade of organisation in the evolution of higher organisms. Based on the latest research, this is a unique account of the origin of life and its evolutionary diversity to the present day. [This volume] proposes a new and unique view of the origin and evolution of life on Earth, weaving the evolution of fungi into the evolution of eukaryotes; explains the origins of all groups of higher organisms (eukaryotes), showing how the features of present-day fungi can account for the ancestral evolution of the eukaryote grade of evolution; emphasises twenty-first-century research in disciplines ranging from astronomy to zoology, providing readers with the
most complete and contemporary treatment of the topic"--Publisher's description. How did life on Earth originate? Did replication or metabolism come first in the history of life? In the second edition of the acclaimed Origins of Life, distinguished scientist and science writer Freeman Dyson examines these questions and discusses the two main theories that try to explain how naturally occurring chemicals could organize themselves into living creatures. The majority view is that life began with replicating molecules, the precursors of modern genes. The minority belief is that random populations of molecules evolved metabolic activities before exact replication existed and that natural selection drove the evolution of cells toward greater complexity for a long time without the benefit of genes. Dyson analyzes both of these theories with reference to recent important discoveries by geologists and chemists, aiming to stimulate new experiments that could help decide which theory is correct. This second edition covers the impact revolutionary discoveries such as the existence of ribozymes, enzymes made of RNA; the likelihood that many of the most ancient creatures are thermophilic, living in hot environments; and evidence of life in the most ancient of all terrestrial rocks in Greenland have had on our ideas about how life began. It is a clearly written, fascinating book that will appeal to anyone interested in the origins of life. Seventy years ago, Erwin Schrödinger posed a profound question: 'What is life, and how did it emerge from non-life?' Scientists have puzzled over it ever since. Addy Pross uses insights from the new field of systems chemistry to show how chemistry can
become biology, and that Darwinian evolution is the expression of a deeper physical principle. This book explores the possibility that life exists on Mars. It provides an interdisciplinary overview of the early evolution of life in hydrothermal ecosystems on Earth, focusing on the problem of remote sensing and incorporating geological work relevant to the search for evidence of early life on Earth and Mars. It discusses the belief that studying thermal spring deposits as part of this search may be the best opportunity to test whether life on earth is a "unique experiment," or whether there is life elsewhere in the solar system. Scientist Robert Hazen attempts to offer a scientific explanation of how life on Earth began nearly four billion years ago, describing the sequence of events that caused non-living chemicals to become alive and create life. Is the emergence of life on Earth the result of a single chance event or combination of lucky accidents, or is it the outcome of biochemical forces woven into the fabric of the universe? And if inevitable, what are these forces, and how do they account not only for the origin of life but also for its evolution toward increasing complexity? Vital Dust is a groundbreaking history of life on Earth, a history that only someone of Christian de Duve's stature and erudition could have written.

Genesis – In The Beginning deals with the origin and diversity of Life and early biological evolution and discusses the question of where (hot or cold sources) and when the beginning of Life took place. Among the sections are chapters dealing with prebiotic chemical processes and considering self-replication of polymers in mineral habitats. One chapter is dedicated to
the photobiological regime on early Earth and the emergence of Life. This volume covers the role of symmetry, information and order (homochiral biomolecules) in the beginning of Life. The models of protocells and the genetic code with gene transfer are important topics in this volume. Three chapters discuss the Panspermia hypothesis (to answer “Are we from outer Space?”). Other chapters cover the Astrobiological aspects of Life in the Universe in extraterrestrial Planets of the Solar System and deal with cometary hydrosphere (and its connection to Earth). We conclude with the history and frontiers of Astrobiology. Uniting the foundations of physics and biology, this groundbreaking multidisciplinary and integrative book explores life as a planetary process.

The renowned science writer, mathematician, and bestselling author of Fermat's Last Theorem masterfully refutes the overreaching claims the "New Atheists," providing millions of educated believers with a clear, engaging explanation of what science really says, how there's still much space for the Divine in the universe, and why faith in both God and empirical science are not mutually exclusive. A highly publicized coterie of scientists and thinkers, including Richard Dawkins, the late Christopher Hitchens, and Lawrence Krauss, have vehemently contended that breakthroughs in modern science have disproven the existence of God, asserting that we must accept that the creation of the universe came out of nothing, that religion is evil, that evolution fully explains the dazzling complexity of life, and more. In this much-needed book, science journalist Amir Aczel profoundly disagrees and conclusively demonstrates that science has not, as yet, provided any definitive proof refuting the existence of God. Why Science Does Not Disprove God is his brilliant and incisive analyses of the theories and findings of such titans as Albert Einstein, Roger Penrose, Alan Guth, and Charles Darwin, all of whose major
breakthroughs leave open the possibility—and even the strong likelihood—of a Creator. Bolstering his argument, Aczel lucidly discourses on arcane aspects of physics to reveal how quantum theory, the anthropic principle, the fine-tuned dance of protons and quarks, the existence of anti-matter and the theory of parallel universes, also fail to disprove God.

Today many school students are shielded from one of the most important concepts in modern science: evolution. In engaging and conversational style, Teaching About Evolution and the Nature of Science provides a well-structured framework for understanding and teaching evolution. Written for teachers, parents, and community officials as well as scientists and educators, this book describes how evolution reveals both the great diversity and similarity among the Earth's organisms; it explores how scientists approach the question of evolution; and it illustrates the nature of science as a way of knowing about the natural world. In addition, the book provides answers to frequently asked questions to help readers understand many of the issues and misconceptions about evolution. The book includes sample activities for teaching about evolution and the nature of science. For example, the book includes activities that investigate fossil footprints and population growth that teachers of science can use to introduce principles of evolution. Background information, materials, and step-by-step presentations are provided for each activity. In addition, this volume: Presents the evidence for evolution, including how evolution can be observed today. Explains the nature of science through a variety of examples. Describes how science differs from other human endeavors and why evolution is one of the best avenues for helping students understand this distinction. Answers frequently asked questions about evolution. Teaching About Evolution and the Nature of Science builds on the 1996 National Science Education Standards released by the National
Research Council--and offers detailed guidance on how to evaluate and choose instructional materials that support the standards. Comprehensive and practical, this book brings one of today's educational challenges into focus in a balanced and reasoned discussion. It will be of special interest to teachers of science, school administrators, and interested members of the community.

'I can recommend this book as a thoroughly interesting read' -Biologist 01/02/2002'
'exhilarating reading... challenging... stimulates the reader to think deeply on the many issues it raises.'
-Margaret Ginzburg, Science and Christian belief, Vol.13, No.1, April 2001'

...the authors provide a clear-eyed review of a large part of modern biology.' -Scientific American'

...the book is well written, stimulating, and full of information nuggets.' -Choice

Our Cosmic Origins, first published in 1998, traces the remarkable story of the emergence of life and intelligence right through the complex evolutionary history of the Universe. Armand Delsemme weaves together a rich tapestry of science, bringing together cosmology, astronomy, geology, biochemistry and biology in this wide-ranging book. In following the complex, chronological story, we discover how the first elements formed in the early Universe, how stars and planets were born, how the first bacteria evolved towards a plethora of plants and animals, and how the coupling of the eye and brain led to the development of self-awareness and, ultimately, intelligence. Professor Delsemme concludes with the tantalising suggestion that the existence of alien life and intelligence is likely, and examines our chances of contacting it. This provocative book provides the general reader with an accessible and wide-ranging account of how life evolved on Earth and how likely it is to exist elsewhere in the Universe.
Are we alone in the universe? How did life arise on our planet? How do we search for life beyond Earth? These profound questions excite and intrigue broad cross sections of science and society. Answering these questions is the province of the emerging, strongly interdisciplinary field of astrobiology. Life is inextricably tied to the formation, chemistry, and evolution of its host world, and multidisciplinary studies of solar system worlds can provide key insights into processes that govern planetary habitability, informing the search for life in our solar system and beyond. Planetary Astrobiology brings together current knowledge across astronomy, biology, geology, physics, chemistry, and related fields, and considers the synergies between studies of solar systems and exoplanets to identify the path needed to advance the exploration of these profound questions. Planetary Astrobiology represents the combined efforts of more than seventy-five international experts consolidated into twenty chapters and provides an accessible, interdisciplinary gateway for new students and seasoned researchers who wish to learn more about this expanding field. Readers are brought to the frontiers of knowledge in astrobiology via results from the exploration of our own solar system and exoplanetary systems. The overarching goal of Planetary Astrobiology is to enhance and broaden the development of an interdisciplinary approach across the astrobiology, planetary science, and exoplanet communities, enabling a new era of comparative planetology that encompasses conditions and processes for the emergence, evolution, and detection of life.
The Earth that sustains us today was born out of a few remarkable, near-catastrophic revolutions, started by biological innovations and marked by global environmental consequences. The revolutions have certain features in common, such as an increase in complexity, energy utilization, and information processing by life. This book describes these revolutions, showing the fundamental interdependence of the evolution of life and its non-living environment. We would not exist unless these upheavals had led eventually to 'successful' outcomes - meaning that after each one, at length, a new stable world emerged. The current planet-reshaping activities of our species may be the start of another great Earth system revolution, but there is no guarantee that this one will be successful. The book explains what a successful transition through it might look like, if we are wise enough to steer such a course. This book places humanity in context as part of the Earth system, using a new scientific synthesis to illustrate our debt to the deep past and our potential for the future.

By one of Britain's most gifted scientists: a magnificently daring and compulsively readable account of life on Earth (from the "big bang" to the advent of man), based entirely on the most original of all sources--the evidence of fossils. With excitement and driving intelligence, Richard Fortey guides us from the barren globe spinning in space, through the very earliest signs of life in the sulphurous hot springs and volcanic vents of the young planet, the appearance of cells, the slow creation of an atmosphere and the evolution of myriad forms of plants and animals that could then be sustained, including
the magnificent era of the dinosaurs, and on to the last moment before the debut of Homo sapiens. Ranging across multiple scientific disciplines, explicating in wonderfully clear and refreshing prose their findings and arguments--about the origins of life, the causes of species extinctions and the first appearance of man--Fortey weaves this history out of the most delicate traceries left in rock, stone and earth. He also explains how, on each aspect of nature and life, scientists have reached the understanding we have today, who made the key discoveries, who their opponents were and why certain ideas won. Brimful of wit, fascinating personal experience and high scholarship, this book may well be our best introduction yet to the complex history of life on Earth. A Book-of-the-Month Club Main Selection With 32 pages of photographs

A reconceptualization of origins research that exploits a modern understanding of non-covalent molecular forces that stabilize living prokaryotic cells. Scientific research into the origins of life remains exploratory and speculative. Science has no definitive answer to the biggest questions--"What is life?" and "How did life begin on earth?" In this book, Jan Spitzer reconceptualizes origins research by exploiting a modern understanding of non-covalent molecular forces and covalent bond formation--a physicochemical approach propounded originally by Linus Pauling and Max Delbrück. Spitzer develops the Pauling-Delbrück premise as a physicochemical jigsaw puzzle that identifies key stages in life's emergence, from the formation of first oceans, tidal sediments, and proto-biofilms to progenotes, proto-cells and the first cellular organisms.
This is the second of a divided two-part softcover edition of the "Lectures in Astrobiology Volume I" containing the sections "General Introduction", "From Prebiotic Chemistry to the Origin of Life on Earth" and "Appendices" including an extensive glossary on Astrobiology. "Lectures in Astrobiology" is the first comprehensive textbook at graduate level encompassing all aspects of the emerging field of astrobiology. Volume I of the Lectures in Astrobiology gathers a first set of extensive lectures that cover a broad range of topics, from the formation of solar systems to the quest for the most primitive life forms that emerged on the Early Earth.

This edition of Science and Creationism summarizes key aspects of several of the most important lines of evidence supporting evolution. It describes some of the positions taken by advocates of creation science and presents an analysis of these claims. This document lays out for a broader audience the case against presenting religious concepts in science classes. The document covers the origin of the universe, Earth, and life; evidence supporting biological evolution; and human evolution. (Contains 31 references.) (CCM)

Addressing the emergence of life from a systems biology perspective, this new edition has undergone extensive revision, reflecting changes in scientific understanding and evolution of thought on the question 'what is life?'. With an emphasis on the philosophical aspects of science, including the epistemic features of modern synthetic biology, and also providing an updated view of the autopoiesis/cognition theory, the
book gives an exhaustive treatment of the biophysical properties of vesicles, seen as the beginning of the 'road map' to the minimal cell - a road map which will develop into the question of whether and to what extent synthetic biology will be capable of making minimal life in the laboratory. Fully illustrated, accessibly written, directly challenging the reader with provocative questions, offering suggestions for research proposals, and including dialogues with contemporary authors such as Humberto Maturana, Albert Eschenmoser and Harold Morowitz, this is an ideal resource for researchers and students across fields including bioengineering, evolutionary biology, molecular biology, chemistry and chemical engineering.

Questions about the origin and nature of Earth and the life on it have long preoccupied human thought and the scientific endeavor. Deciphering the planet's history and processes could improve the ability to predict catastrophes like earthquakes and volcanic eruptions, to manage Earth's resources, and to anticipate changes in climate and geologic processes. At the request of the U.S. Department of Energy, National Aeronautics and Space Administration, National Science Foundation, and U.S. Geological Survey, the National Research Council assembled a committee to propose and explore grand questions in geological and planetary science. This book captures, in a series of questions, the essential scientific challenges that constitute the frontier of Earth science at the start of the 21st century.

Habitability of the Universe before Earth: Astrobiology: Exploring Life on Earth and
Beyond (series) examines the times and places—before life existed on Earth—that might have provided suitable environments for life to occur, addressing the question: Is life on Earth de novo, or derived from previous life? The universe changed considerably during the vast epoch between the Big Bang 13.6 billion years ago and the first evidence of life on Earth 4.1 billion years ago, providing significant time and space to contemplate where, when and under what circumstances life might have arisen. No other book covers this cosmic time period from the point of view of its potential for life. The series covers a broad range of topics encompassing laboratory and field research into the origins and evolution of life on Earth, life in extreme environments and the search for habitable environments in our solar system and beyond, including exoplanets, exomoons and astronomical biosignatures. Provides multiple hypotheses on the origin of life and distribution of living organisms in space Explores the diversity of physical environments that may support the origin and evolution of life Integrates contemporary views in biology and cosmology, and provides reasons that life is far more mobile in space than most people expect Includes access to a companion web site featuring supplementary information such as animated computer simulations

In Origins of Existence astrophysicist Fred Adams takes a radically different approach from the long tradition of biologists and spiritual leaders who have tried to explain how the universe supports the development of life. He argues that life followed naturally from the laws of physics -- which were established as the universe burst into existence
at the big bang. Those elegant laws drove the formation of galaxies, stars, and planets -- including some like our Earth. That chain of creation produced all the tiny chemical structures and vast celestial landscapes required for life. Ultimately, physical laws and the complexity they generate define the kind of biospheres that are possible -- from an Amazon rain forest to a frigid ocean beneath an ice sheet on a Jovian moon. Adams suggests that life was not merely some lucky break, but rather a natural outcome of the ascending ladder of complexity supported by our universe. Since our galaxy seems to harbor millions of planets with the same basic elements of habitability as Earth, the emergence of life is probably not a rare event. If life emerges deep inside planets and moons, as new research suggests happened on our planet, the number of viable habitats is truly enormous. Seven chronological chapters take the reader from the laws of physics and birth of the universe to the origins of life on Earth -- showing how energy flowed, exploded, and was repeatedly harnessed in replicating structures and organisms. In his groundbreaking first book, Fred Adams established the five eras of the universe with a focus on its long-term future. It is perhaps not surprising that he now turns his attention to the mystery of our astronomical origins. Here is a stunning new perspective, a book of genesis for our time, revealing how the laws of physics created galaxies, stars, planets, and even life in the universe. This volume explores the historical and current theories about the origin of life, addressing in particular the three key puzzles of how and when life began on Earth and
in what form. This pathbreaking book explores how life can begin, taking us from cosmic clouds of stardust, to volcanoes on Earth, to the modern chemistry laboratory. Seeking to understand life’s connection to the stars, David Deamer introduces astrobiology, a new scientific discipline that studies the origin and evolution of life on Earth and relates it to the birth and death of stars, planet formation, interfaces between minerals, water, and atmosphere, and the physics and chemistry of carbon compounds. Deamer argues that life began as systems of molecules that assembled into membrane-bound packages. These in turn provided an essential compartment in which more complex molecules assumed new functions required for the origin of life and the beginning of evolution. Deamer takes us from the vivid and unpromising chaos of the Earth four billion years ago up to the present and his own laboratory, where he contemplates the prospects for generating synthetic life. Engaging and accessible, First Life describes the scientific story of astrobiology while presenting a fascinating hypothesis to explain the origin of life.

The Origin of Life on the Earth covers the proceedings of the First International Symposium of The Origin of Life on the Earth, held at Moscow on August 19-24, 1957. This symposium brings together numerous scientific studies on the evolutionary principles and the different stages in the evolutionary development of matter. This book is organized into seven parts encompassing 60 chapters. The first parts discuss
evidence that on the formation of hydrocarbons and their derivatives on the surface of the Earth even before the emergence of life. The subsequent parts are devoted to the many asymmetrical syntheses under the influence of circularly-polarized ultraviolet light, by catalytic reactions occurring on the surface of quartz crystals, and spontaneously by slow crystallization from solutions. These topics are followed by reviews on the possible means of abiogenic formation of amino acids, porphyrins, protein-like polymers, polynucleotides and other high-molecular organic compounds. Considerable chapters explore the complete possibility of the primary formation of these compounds on the surface of the Earth even before life was present on it. Other general topics covered include nucleic acids, nucleoproteins and viruses. The last part considers general biochemical problems connected with the further development of metabolism. This book will be of value to astronomers, physicists, geologists, chemists, and biologists.

The stewards of Earth, these organisms transformed the chemistry of our planet to make it habitable for plants, animals, and us.

This book provides a comprehensive treatment of the chemical nature of the Earth’s early surface environment and how that led to the origin of life. This includes a detailed discussion of the likely process by which life emerged using as much quantitative information as possible. The emergence of life and the prior surface conditions of the Earth have implications for the evolution of Earth’s surface environment over the
following 2-2.5 billion years. The last part of the book discusses how these changes took place and the evidence from the geologic record that supports this particular version of early and evolving conditions.

The history of life on Earth is, in some form or another, known to us all—or so we think. A New History of Life offers a provocative new account, based on the latest scientific research, of how life on our planet evolved—the first major new synthesis for general readers in two decades. Charles Darwin's theories, first published more than 150 years ago, form the backbone of how we understand the history of the Earth. In reality, the currently accepted history of life on Earth is so flawed, so out of date, that it's past time we need a 'New History of Life.' In their latest book, Joe Kirschvink and Peter Ward will show that many of our most cherished beliefs about the evolution of life are wrong.

Gathering and analyzing years of discoveries and research not yet widely known to the public, A New History of Life proposes a different origin of species than the one Darwin proposed, one which includes eight-foot-long centipedes, a frozen “snowball Earth”, and the seeds for life originating on Mars. Drawing on their years of experience in paleontology, biology, chemistry, and astrobiology, experts Ward and Kirschvink paint a picture of the origins life on Earth that are at once too fabulous to imagine and too familiar to dismiss—and looking forward, A New History of Life brilliantly assembles insights from some of the latest scientific research to understand how life on Earth can and might evolve far into the future.