

Life On A Young Planet The First Three Billion Years Of Evolution On Earth The First Three Billion Years Of Evolution On Earth Andrew H Knoll

At first, nothing lived on Earth. It was a noisy, hot, scary place. Choking gas exploded from volcanoes and oceans of lava bubbled around the globe... Then in the deep, dark ocean, something amazing happened. This is an exciting and dramatic story about how life began and developed on Planet Earth, written especially for younger children. The authors explain how the first living cell was created, and how the cells multiply and create jellyfish and worms, and then fish with bendy necks, which drag themselves out of the water into swampy forests. They tell the story of the biggest creatures that have ever walked on land - the dinosaurs. Long after that, hairy creatures who have babies, not eggs, take over, stand on two legs and spread around the world, some of them living through cataclysmic events such as ice ages and volcanic eruptions. Everyone living today is related to these survivors. With delightful illustrations including lots of detail and humour, all carefully researched and checked, this book shows the development of life on Earth in a truly accessible and simple way.

Every rock is a tangible trace of the earth's past. *The Story of the Earth in 25 Rocks* tells the fascinating stories behind the discoveries that shook the foundations of geology. In twenty-five chapters—each about a particular rock, outcrop, or geologic phenomenon—Donald R. Prothero recounts the scientific detective work that shaped our understanding of geology, from the unearthing of exemplary specimens to tectonic shifts in how we view the inner workings of our planet. Prothero follows in the footsteps of the scientists who asked—and answered—geology's biggest questions: How do we know how old the earth is? What happened to the supercontinent Pangea? How did ocean rocks end up at the top of Mount Everest? What can we learn about our planet from meteorites and moon rocks? He answers these questions through expertly chosen case studies, such as Pliny the Younger's firsthand account of the eruption of Vesuvius; the granite outcrops that led a Scottish scientist to theorize that the landscapes he witnessed were far older than Noah's Flood; the salt and gypsum deposits under the Mediterranean Sea that indicate that it was once a desert; and how trying to date the age of meteorites revealed the dangers of lead poisoning. Each of these breakthroughs filled in a piece of the greater puzzle that is the earth, with scientific discoveries dovetailing with each other to offer an increasingly coherent image of the geologic past. Summarizing a wealth of information in an entertaining, approachable style, *The Story of the Earth in 25 Rocks* is essential reading for the armchair geologist, the rock hound, and all who are curious about the earth beneath their feet.

Astrobiology is a remarkably interdisciplinary field. This reference serves as a key to understanding technical terms from the different subfields of astrobiology, including astronomy, biology, chemistry, the geosciences and the space sciences.

Considering the development of life on Earth, the existence of life in extreme environments and the potential for life elsewhere in the Universe, this book gives a fascinating insight into our place in the Universe. Chris Impey leads the reader through the history, from the Copernican revolution to the emergence of the field of astrobiology – the study of life in the cosmos. He examines how life on Earth began, exploring its incredible variety and the extreme environments in which it can survive. Finally, Impey turns his attention to our Solar System and the planets beyond, discussing whether there may be life elsewhere in the Universe. Written in non-technical language, this book is ideal for anyone wanting to know more about astrobiology and how it is changing our views of life and the Universe. An accompanying website available at www.cambridge.org/9780521173841 features podcasts, articles and news stories on astrobiology.

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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*.

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National Book Award Finalist: A biologist's "thoroughly enjoyable" account of the expeditions that unearthed the history of life on our planet (Publishers Weekly). Not so long ago, most of our world was an unexplored wilderness. Our sense of its age was vague and vastly off the mark, and much of the knowledge of our own species' history was a set of fantastic myths and fairy tales. But scientists were about to embark on an amazing new era of understanding. From the New York Times—bestselling author of *The Big Picture*, this book leads us on a rousing voyage that recounts the most important discoveries in two centuries of natural history: from Darwin's trip around the world to Charles Walcott's discovery of pre-Cambrian life in the Grand Canyon; from Louis and Mary Leakey's investigation of our deepest past in East Africa to the trailblazers in modern laboratories who have located a time clock in our DNA. Filled with the same sense of adventure that spurred on these extraordinary men and women, *Remarkable Creatures* is a "stirring introduction to the wonder of evolutionary biology" (Kirkus Reviews). "Charming and enlightening." —San Francisco Chronicle "As fast-paced as a detective story." —Nature

The senior paleontologist at London's Natural History Museum presents an account of life on Earth from the Big Bang to the advent of humankind, based entirely on the evidence of fossils, stones, and other natural artifacts.

Feeling pressured and unhappy in her everyday life, a young girl welcomes the opportunity of having a look-alike life-size doll take her place at school and at home.

Long before Galileo published his discoveries about Jupiter, lunar craters, and the Milky Way in the *Starry Messenger* in 1610, people were fascinated with the planets and stars around them. That interest continues today, and scientists are making new discoveries at an astounding rate. Ancient lake beds on Mars, robotic spacecraft missions, and new definitions of planets now dominate the news. How can you take it all in? Start with the new *Encyclopedia of the Solar System, Second Edition*. This self-contained reference follows the trail blazed by the bestselling first edition. It provides a framework for understanding the origin and evolution of the solar system, historical discoveries, and details about planetary bodies and how they interact—and has jumped light years ahead in terms of new information and visual impact. Offering more than 50% new material, the *Encyclopedia* includes the latest explorations and observations, hundreds of new color digital images and illustrations, and more than 1,000 pages. It stands alone as the definitive work in this field, and will serve as a modern messenger of scientific discovery and provide a look into the future of our solar system. · Forty-seven chapters from 75+ eminent authors review fundamental topics as well as new models, theories, and discussions · Each entry is detailed and scientifically rigorous, yet accessible to

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undergraduate students and amateur astronomers · More than 700 full-color digital images and diagrams from current space missions and observatories amplify the chapters · Thematic chapters provide up-to-date coverage, including a discussion on the new International Astronomical Union (IAU) vote on the definition of a planet · Information is easily accessible with numerous cross-references and a full glossary and index

In *Origins*, Frank H. T. Rhodes explores the origin and evolution of living things, the changing environments in which they have developed, and the challenges we now face on an increasingly crowded and polluted planet.

Kipp Herreid learned other ways to teach—much better ways. His favorite approach puts science in vivid context through case studies, which he calls "stories with an educational message." This compilation of 40-plus essays examines every aspect of the case study method.--[back cover].

A thrilling tour of the sea's most extreme species, coauthored by one of the world's leading marine scientists The ocean teems with life that thrives under difficult situations in unusual environments. *The Extreme Life of the Sea* takes readers to the absolute limits of the ocean world—the fastest and deepest, the hottest and oldest creatures of the oceans. It dives into the icy Arctic and boiling hydrothermal vents—and exposes the eternal darkness of the deepest undersea trenches—to show how marine life thrives against the odds. This thrilling book brings to life the sea's most extreme species, and tells their stories as characters in the drama of the oceans. Coauthored by Stephen Palumbi, one of today's leading marine scientists, *The Extreme Life of the Sea* tells the unforgettable tales of some of the most marvelous life forms on Earth, and the challenges they overcome to survive. Modern science and a fluid narrative style give every reader a deep look at the lives of these species. *The Extreme Life of the Sea* shows you the world's oldest living species. It describes how flying fish strain to escape their predators, how predatory deep-sea fish use red searchlights only they can see to find and attack food, and how, at the end of her life, a mother octopus dedicates herself to raising her batch of young. This wide-ranging and highly accessible book also shows how ocean adaptations can inspire innovative commercial products—such as fan blades modeled on the flippers of humpback whales—and how future extremes created by human changes to the oceans might push some of these amazing species over the edge.

Given the universal interest in whether extraterrestrial life has developed or could eventually develop, it is vital that an examination of planetary habitability go beyond simple assumptions. This book has resulted from a workshop at the International Space Science Institute (ISSI) which brought together experts to discuss the multi-faceted problem of how the habitability of a planet co-evolves with the geology of the surface and interior, the atmosphere, and the magnetosphere.

Knoll explores the deep history of life from its origins on a young planet to the incredible Cambrian explosion, with the very latest discoveries in paleontology integrated with emerging insights from molecular biology and earth system science. 100 illustrations.

The ideal textbook resource to support a one-semester capstone course in planetary processes for geoscience undergraduates.

Informed by new planetary discoveries and the findings from recent robotic missions to Mars, Jupiter, and Saturn, scientists are rapidly replacing centuries of speculation about potential extraterrestrial habitats with real knowledge about the possibility of life outside our own biosphere—if it exists, and where. This second edition of Kevin W. Plaxco and Michael Gross's widely acclaimed text incorporates the latest research in astrobiology to bring readers the most comprehensive, up-to-date, and engaging introduction to the field available. Plaxco and Gross expand their examination of the origin of chemical elements, the developments that made the Universe habitable, and how life continues to be sustained. They discuss in great detail the formation of the first galaxies and stars, the diverse chemistry of the primordial

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planet, the origins of metabolism, the evolution of complex organisms, and the feedback regulation of Earth's climate. They also explore life in extreme habitats, potential extraterrestrial habitats, and the current status of the search for extraterrestrial life. Weaving together the relevant threads of astronomy, geology, chemistry, biophysics, and microbiology, this broadly accessible introductory text captures the excitement, controversy, and progress of the dynamic young field of astrobiology. New to this edition is a glossary of terms and an epilogue recapping the key unanswered questions, making *Astrobiology* an ideal primer for students and, indeed, for anyone curious about life and the Universe.

God Is Here to Stay offers new insights into one of humankind's most profound questions: Does God exist? During the past ten years, theists and new atheists have argued to prove or disprove God's existence. Examining the pros and cons of each side leads to one overarching conclusion: The existence of God can be neither proven nor disproven with complete certainty, even though both sides draw on modern science to support their views. Drs. Thomas R. McFaul and Al Brunsting approach the question of God's existence from an entirely fresh perspective. They examine scientific knowledge in several areas ranging across the physical sciences and human experience to explain how the universe operates within very narrow and highly structured boundaries. Most importantly, they create an innovative "L-M Confidence Scale" to establish confidence levels, not proofs, on how scientific discoveries impact belief in God. McFaul and Brunsting describe the three stages of scientific evolution. In stage 1, the world's religions developed divergent pre-scientific views. Modern science started with stage 2, during which atheists predicted that science would eventually eradicate religion. In stage 3, the authors show how science, evolution, and belief in God have become increasingly integrated and mutually supportive.

This is a memoir with a difference, Its author, Air Marshal Sir Peter Horsley, was deprived in his earliest years of both parents. The youngest by several years of a family of seven, he has what he himself describes as 'a miserable start'. Though given a traditional middle-class upbringing through the generosity of relations, his restless spirit led him to leave school and go to sea, living a tough life as a cross between a cadet and a deck hand before escaping once again- on this occasion to join the Royal Air Force on the outbreak of war in 1939. While Peter Horsley's career in the RAF necessarily forms much of the backcloth to his story there is so much more here besides. He sees his life as a house, each room of which marks an incident or period of such intensity that it altered his whole pattern of life thereafter. The corridors between those rooms mark the passage of time. Some of the incidents he describes brought him into great danger and very close to death- as when he survived three days and nights adrift in a rubber dinghy in storm force conditions, having been shot down during a night on the Cherbourg Peninsular and, much more recently, when he and his car were used as the innocent tools in a terrorist gang to bring about the murder of a former officer of the Special Air Service. Others had a deep effect for quite different reasons- such as the seven years in the personal service of Her Majesty the Queen and HRH Prince Philip as Equerry, or his intriguing encounters with psychic phenomena, all true but described in town-to-earth terms which make no attempt to explain the inexplicable. Peter Horsley is an intensely human and sympathetic man and his writing contains many passages of great sensitivity. His description of the storm which so very nearly cost him his life must stand as a classic amongst Second World War stories.

A quantitative introduction to the Solar System and planetary systems science for advanced undergraduate students, this engaging new textbook explains the wide variety of physical, chemical and geological processes that govern the motions and properties of planets. The authors provide an overview of our current knowledge and discuss some of the unanswered questions at the forefront of research in planetary science and astrobiology today. They combine knowledge of the Solar System and the properties of extrasolar planets with

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astrophysical observations of ongoing star and planet formation, offering a comprehensive model for understanding the origin of planetary systems. The book concludes with an introduction to the fundamental properties of living organisms and the relationship that life has to its host planet. With more than 200 exercises to help students learn how to apply the concepts covered, this textbook is ideal for a one-semester or two-quarter course for undergraduate students.

This well illustrated book presents a compact history of the Solar System from its dusty origins 4,600,000 years ago to the present day. Its primary aim is to show how the planets and their satellites, comets, meteors, interplanetary dust, solar radiation and cosmic rays continually interact, sometimes violently, and it reflects humanity's progress in exploring and interpreting this history. The book is intended for a general readership at a time when human and robotic exploration of space is often in the news and should also appeal to students at all levels. It covers the essentials but refers to a large literature which can be accessed via the internet.

The Secret of the Ninth Planet (Chinese edition)

What do scientists know about the possibility of life outside our solar system? How does Catholic science ?ction imagine such worlds? What are the implications for Catholic thought? This collection brings together leading scientists, philosophers, theologians, and science fiction authors in the Catholic tradition to examine these issues. In the first section, Christian scientists detail the latest scientific findings regarding the possibility of life on exoplanets. The second part brings together leading Catholic science fiction authors who describe how "alien" life forms have been prevalent in the Catholic imagination from the Middle Ages right up to the present day. In the final section, Catholic philosophers and theologians examine the implications of discovering intelligent life elsewhere in the universe. Rather than worrying that the discovery of intelligent extraterrestrials might threaten the dignity of humans or their existence, the contributors here maintain that such creatures should be welcomed as fellow creatures of God and potential subjects of divine salvation.

With over 500 planets now known to exist beyond the Solar System, spacecraft heading for Mars, and the ongoing search for extraterrestrial intelligence, this timely book explores current ideas about the search for life in the Universe. It contains candid interviews with dozens of astronomers, geologists, biologists, and writers about the origin and range of terrestrial life and likely sites for life beyond Earth. The interviewees discuss what we've learnt from the missions to Mars and Titan, talk about the search for Earth clones, describe the surprising diversity of life on Earth, speculate about post-biological evolution, and explore what contact with intelligent aliens will mean to us. Covering topics from astronomy and planetary science to geology and biology, this book will fascinate anyone who has ever wondered 'Are we alone?'

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The Latest Scientific Discoveries Point to an Intentional Creator Most of us remember the basics from science classes about how Earth came to be the only known planet that sustains complex life. But what most people don't know is that the more thoroughly researchers investigate the history of our planet, the more astonishing the story of our existence becomes. The number and complexity of the astronomical, geological, chemical, and biological features recognized as essential to human existence have expanded explosively within the past decade. An understanding of what is required to make possible a large human population and advanced civilizations has raised profound questions about life, our purpose, and our destiny. Are we really just the result of innumerable coincidences? Or is there a more reasonable explanation? This fascinating book helps nonscientists understand the countless miracles that undergird the exquisitely fine-tuned planet we call home--as if Someone had us in mind all along.

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

One of Springer's Major Reference Works, this book gives the reader a truly global perspective. It is the first major reference work in its field. Paleoclimate topics covered in the encyclopedia give the reader the capability to place the observations of recent global warming in the context of longer-term natural climate fluctuations. Significant elements of the encyclopedia include recent developments in paleoclimate modeling, paleo-ocean circulation, as well as the influence of geological processes and biological feedbacks on global climate change. The encyclopedia gives the reader an entry point into the literature on these and many other groundbreaking topics.

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"A sublime chronicle of our planet. -Booklist, STARRED review Harvard's acclaimed geologist "charts Earth's history in accessible style" (AP) How well do you know the ground beneath your feet? Odds are, where you're standing was once cooking under a roiling sea of lava, crushed by a towering sheet of ice, rocked by a nearby meteor strike, or perhaps choked by poison gases, drowned beneath ocean, perched atop a mountain range, or roamed by fearsome monsters. Probably most or even all of the above. The story of our home planet and the organisms spread across its surface is far more spectacular than any Hollywood blockbuster, filled with enough plot twists to rival a bestselling thriller. But only recently have we begun to piece together the whole mystery into a coherent narrative. Drawing on his decades of field research and up-to-the-minute understanding of the latest science, renowned geologist Andrew H. Knoll delivers a rigorous yet accessible biography of Earth, charting our home planet's epic 4.6 billion-year story. Placing twenty first-century climate change in deep context, A Brief History of Earth is an indispensable look at where we've been and where we're going. Features original illustrations depicting Earth history and nearly 50 figures (maps, tables, photographs, graphs).

The animals we find today in a tidepool reflect the winners and losers of an event 250 million years ago when the Earth suffered the greatest biotic crisis in its history, with some 95% of all living species being wiped out. This text explores the possible causes of this mass extinction.

This interdisciplinary book consists of the proceedings of the Alexander Ivanovich Oparin 100th Anniversary Conference, The Third Trieste Conference on Chemical Evolution, which took place at the International Centre for Theoretical Physics from 29 August till 2 September, 1994. A general overview of Oparin's life and work is followed by a review of Alfonso Herrera, another pioneer in the studies of the origin of life. The subject matter is organized in ten sections corresponding to various aspects of our current understanding of the subject that was initiated by Oparin. These subjects were covered by fifty three speakers. There were sixty seven participants from a wide geographical distribution; twenty seven countries were represented. We have included the invited lecture of Professor Igor Kulaev, who was unable to be present at the conference for reasons beyond his control. The conference was generously supported by the International Centre for Theoretical Physics, the Commission of the European Communities, the International Centre for Genetic Engineering and Biotechnology, the International Centre for Science and High Technology, and UNESCO. Cyril Ponnamperna, University of Maryland, U.S.A. Julian Chela-Flores, ICTP, Italy, and

IDEA, Venezuela. xi FOREWORD As this volume was going to press we learnt of the untimely death of Cyril Ponnampereuma who died of cardiac arrest on December 20, 1994.

"In this scientifically informed account of the changes occurring in the world over the last century, award-winning broadcaster and natural historian shares a lifetime of wisdom and a hopeful vision for the future. See the world. Then make it better. I am 93. I've had an extraordinary life. It's only now that I appreciate how extraordinary. As a young man, I felt I was out there in the wild, experiencing the untouched natural world - but it was an illusion. The tragedy of our time has been happening all around us, barely noticeable from day to day -- the loss of our planet's wild places, its biodiversity. I have been witness to this decline. A Life on Our Planet is my witness statement, and my vision for the future. It is the story of how we came to make this, our greatest mistake -- and how, if we act now, we can yet put it right. We have one final chance to create the perfect home for ourselves and restore the wonderful world we inherited. All we need is the will to do so"--

When Stephen Hawking, the most famous scientist living in the twenty-first century, published *The Grand Design*, he provoked a lively response in the media. Hawking wrote that the laws of physics make God unnecessary when explaining the origin of the universe and everything in it. In *Is God Unnecessary?*, author Walter Alan Ray presents nine reasons why Hawking's thesis is mistaken. Ray does not use philosophical or theological arguments, but presents the same laws of physics that Hawking says demonstrate his position. Ray examines • Hawking's "Apparent Miracle"; • Hawking's assumption that Charles Darwin explained the origin of human life; • the question "Can something come out of nothing?"; • the cosmological constant in Einstein's equations, the factor that Hawking considers the most impressive coincidence; • Hawking's solution to the "completely incomprehensible" value of the cosmological constant; and • how physics and mathematics join in showing that in the current state of our knowledge, physics and mathematics do have something to say about the origin of the universe. Ray determines that the laws of physics and mathematics show there are two possible answers to the question "How did we come to live in a universe that is as astoundingly fine-tuned as ours?". The arguments presented by Ray in *Is God Unnecessary?* prove neither of these two answers is the solution proposed by Hawking.

"Biogeochemistry considers how the basic chemical conditions of the Earth—from atmosphere to soil to seawater—have been and are being affected by the existence of life. Human activities in particular, from the rapid consumption of resources to the destruction of the rainforests and the expansion of smog-covered cities, are leading to rapid changes in the basic chemistry of the Earth. This expansive text pulls together the numerous fields of study encompassed by biogeochemistry to analyze the increasing demands of the growing human population on limited resources and the resulting changes in the planet's

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chemical makeup. The book helps students extrapolate small-scale examples to the global level, and also discusses the instrumentation being used by NASA and its role in studies of global change. With extensive cross-referencing of chapters, figures and tables, and an interdisciplinary coverage of the topic at hand, this updated edition provides an excellent framework for courses examining global change and environmental chemistry, and is also a useful self-study guide."--Publisher's website.

In this salutation from Earth, the chronicler gives a tour of the planet and introduces those who call it home.

Virtually all life on Earth, from bacteria to humans, needs iron to survive. From facilitating oxygen flow in mammals to assisting migrating birds in finding their way south for the winter, iron serves a variety of definitive roles for nearly all living creatures. Our knowledge of iron's role in life is the result of recent discoveries about iron and magnetism in bacteria, in myriad animals and plant species, and in humans. Personal stories of scientists illustrate the lively interplay between molecular biologists, ornithologists, physicists, oceanographers, chemists, geologists, physicians, and ecologists. The authors start with the discovery of iron-rich hot springs on the ocean floor. Was this life's nursery? Other chapters describe why there is iron in our blood and how the body safely cages excess iron. The physiology of exercise and the genetic blood diseases, sickle cell anemia, hemochromatosis, and the thalassemias are explained. One of nature's most dramatic mysteries--the migration of birds, turtle, salmon and other animals--depends on iron magnets. The bodies of some animals contain minute deposits of magnetite that are sensory navigators. Far reaching in scope, Iron, Nature's Universal Element also looks at global issues including iron's power over the earth's oceans, vegetation, and populations; and the low-protein diets that lead to long-term cognitive damage in iron-deficient children in poor countries.

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