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Life in Space Astrobiology for a General Reader *Planetary Astrobiology* **New Frontiers in Astrobiology** *Complete Course in Astrobiology Science, Society, and the Search for Life in the Universe Astrobiology and Space Medicine Searching for Life Across Space and Time Astrobiology* Astrobiology, Discovery, and Societal Impact **An Astrobiology Strategy for the Search for Life in the Universe** *Space, Time, and Aliens* **Astrobiology** Extrasolar Planets and Astrobiology **Astrobiology: A Very Short Introduction** *Astrobiology and the Search for Life in the Universe* **All These Worlds Are Yours** *The Living Universe Extremophiles as Astrobiological Models* **Astrobiology on the International Space Station The Astrobiological Landscape Life in the Universe Social and Conceptual Issues in Astrobiology Life on Earth - and Beyond An Assessment of Balance in NASA's Science Programs** *Assessment of the NASA Astrobiology Institute* **Astrochemistry** Alien Oceans **Alien Life Imagined Encyclopedia of Astrobiology Planet Formation and Panspermia** The Ethics of Space Exploration *Astrobiology* Diseases from Space **Astrobiology An Astrobiology Strategy for the Exploration of Mars** Report Series: Committee on Astrobiology and Planetary Science *Astrobiology* **Our Cosmic Ancestry in the Stars** Astrobiology of Earth

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Inside the epic quest to find life on the water-rich moons at the outer reaches of the solar system Where is the best place to find life beyond Earth? We often look to Mars as the most promising site in our solar system, but recent scientific missions have revealed that some of the most habitable real estate may actually lie farther away. Beneath the frozen crusts of several of the small, ice-covered moons of Jupiter and Saturn lurk vast oceans that may have existed for as long as Earth, and together may contain more than fifty times its total volume of liquid water. Could there be organisms living in their depths? Alien Oceans reveals the science behind the thrilling quest to find out. Kevin Peter Hand is one of today's leading NASA scientists, and his pioneering research has taken him on expeditions around the world. In this captivating account of scientific discovery, he brings together insights from planetary science, biology, and the adventures of scientists like himself to explain how we know that oceans exist within moons of the outer solar system, like Europa, Titan, and Enceladus. He shows how the exploration of Earth's oceans is informing our understanding of the potential habitability of these icy moons, and draws lessons from what we have learned about the origins of life on our own planet to consider how life could arise on these distant worlds. Alien Oceans describes what lies ahead in our search for life in our solar system and

beyond, setting the stage for the transformative discoveries that may await us. New Frontiers in Astrobiology presents a simple and concise overview of the new and emerging field of Astrobiology. A wide range of topics from History of Astrobiology, Big Bang, Prebiotic chemistry, Theories of Origin of Life, and Extreme environments on Earth and Quest for Intelligent life in Space are covered. The hallmark of this book is that it takes critical perspectives to analyze new Frontiers in Astrobiology post Mars 2020/ExoMars missions that encompass the latest developments in detection of biosignatures and habitability beyond our Solar system (Exo moons, exoplanets). This book will be a valuable resource for students, researchers and scientists who seek greater insights in understanding the current status and future of astrobiology. Explores background and historical developments in Astrobiology Provides concise, cutting-edge reviews on fundamental questions on the origin and distribution of life on Earth, habitability beyond Earth, and the future of life on Earth Integrates contemporary and critical views on new frontiers in Astrobiology Is there life beyond Earth? NASA astrobiologist Dr. Chris McKay has searched the earth's most extreme environments on his quest to understand what factors are necessary to sustain life. Pamela S. Turner offers readers an inside look at Dr. McKay's research, explaining his findings and his hopes for future exploration both on Earth and beyond. Behind-the-scenes photos capture Dr. McKay, his expeditions, and the amazing microbes that survive against all odds. This up-to-date resource is based on lectures developed by experts in the relevant fields and carefully edited by the leading astrobiologists within the European community. Aimed at graduate students in physics, astronomy and biology and their lecturers, the text begins with a general introduction to astrobiology, followed by sections on basic prebiotic chemistry, extremophiles, and habitability in our solar system and beyond. A discussion of astrodynamics leads to a look at experimental facilities and instrumentation for space experiments and, ultimately, astrobiology missions, backed in each case by the latest research results from this fascinating field. Includes a CD-ROM with additional course material. In this comprehensive and interdisciplinary volume, former NASA Chief Historian Steven Dick reflects on the exploration of space, astrobiology and its implications, cosmic evolution, astronomical institutions, discovering and classifying the cosmos, and the philosophy of astronomy. The unifying theme of the book is the connection between cosmos and culture, or what Carl Sagan many years ago called the “cosmic connection.” As both an astronomer and historian of science, Dr. Dick has been both a witness to and a participant in many of the astronomical events of the last half century. This collection of papers presents his reflections over the last forty years in a way accessible to historians, philosophers, and scientists alike. From the search for alien life to ongoing space exploration efforts, readers will find this volume full of engaging topics relevant to science, society, and our collective future on planet Earth and beyond. This work is aimed at the upper-level astrobiology course and places a strong emphasis on the astronomy perspective. Astrobiology is the study of the origin, evolution, distribution, and future of life in the universe. It is an inherently interdisciplinary field that encompasses astronomy, biology, geology, heliophysics, and planetary science, including complementary laboratory activities and field studies conducted in a wide range of terrestrial environments. Combining inherent scientific interest and public appeal, the search for life in the solar system and beyond provides a scientific rationale for many current and future activities carried out by the National Aeronautics and Science Administration (NASA) and other national and international agencies and organizations. Requested by NASA, this study offers a science strategy for astrobiology that outlines key scientific questions, identifies the most promising research in the field, and indicates the extent to which the mission priorities in existing decadal surveys address the search for life's origin, evolution, distribution, and future in the universe. This report makes recommendations for advancing the research, obtaining the measurements, and realizing NASA's goal to search for signs of life in the universe. Whether you are a scientist, laureate, professor, college student, high school student or a beginner, this book is meant to educate and introduce the most fascinating and interesting field of the modern science. Where the principles of Quantum physics and postulates of modern mathematics get infused with chemical and life sciences in the broth of space science. Where several mysteries got revealed and some are yet to reveal.Where Astrobiology explains fascinating interdisciplinary scientific field which addresses many questions like: How was the origin of life? How was early evolution? Are we alone in the universe? How did life distribute? What is the future of life in universe? It also addresses the question of how humans can detect extraterrestrial life, if it does exist.Modern day Quantum physics and mathematics are in a race to invent a best possible way or technology to travel in the universe and also helps to figure out the challenges we are going to face while space travel.Space medicine tells about the practice of medicine on astronauts in outer space but it also includes all aspects of preventative medicine like screening, health care delivery and maintaining astronauts' performance in the extreme environment of space and maintaining the long-term health of space travellers.This book, Astrobiology and Space Medicine, covers the basic concepts of evolution, astrobiology, and microbes in extreme earth environments and at ISS, effects of space extremes on human body and how to deal with them through space medicine as well as the future in space. This is one of a kind book, which covers many exciting topics and their interactions with each other. The major goal of this book is to create interest and awareness in people about the exciting topics of astrobiology and space medicine. There is so much out there in space undiscovered waiting for new generation of future scientists, laureates, discoverers and explorers to get explored and discovered.So, I and the whole team of authors urge you to embark the zeal of science in you and join the race of invention and discoveries by giving birth of a scientist in you.Have a good experience of reading this book. Astrobiology is a scientific discipline devoted to the study of life in the universe - its origin, evolution, distribution, and future. In 1997, NASA established an Astrobiology program (the NASA Astrobiology Institute - NAI) as a result of a series of new results from solar system exploration and astronomical research in the mid-1990s together with advances in the biological sciences. To help evaluate the NAI, NASA asked the NRC to review progress made by the Institute in developing the field of astrobiology. This book presents an evaluation of NAI's success in meeting its goals for fostering interdisciplinary research, training future astrobiology researchers, providing scientific and technical leadership, exploring new research approaches with information technology, and supporting outreach to K-12 education programs. Examines humanistic aspects of astrobiology, exploring approaches, critical issues, and implications of the discovery of extraterrestrial life. 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. 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. Are we alone in the universe? As humans, are we unique or are we part of a greater cosmic existence? What is lifeÕs future on Earth and beyond? How does life begin and develop? These are age-old questions that have inspired wonder and controversy ever since the first people looked up into the sky. With todayÕs technology, however, we are closer than ever to finding the answers. Astrobiology is the relatively new, but fast growing scientific discipline that involves trying to understand the origin, evolution, and distribution of life within the universe. It is also one of the few scientific disciplines that attracts the publicÕs intense curiosity and attention. This interest stems largely from the deep personal meaning that the possible existence of extraterrestrial life has for so many. Whether this meaning relates to addressing the ÒBig QuestionsÓ of our existence, the possibility of encountering life on other planets, or the potential impact on our understanding of religion, there is no doubt that the public is firmly vested in finding answers. In this broadly accessible introduction to the field, Bruce Jakosky looks at the search for life in the universe not only from a scientific perspective, but also from a distinctly social one. In lucid and engaging prose, he addresses topics including the contradiction between the publicÕs fascination and the meager dialogue that exists between those within the scientific community and those outside of it, and what has become some of the most impassioned political wrangling ever seen in government science funding. Life is a property of the universe. We may not know how it began or where else it exists, but we have come to know a great deal about how it relates to stars, planets, and the larger cosmos. In clear and compelling terms, this book shows how the emerging field of astrobiology investigates the nature of life in space. How did life begin? How common is it? Where do we fit in? These are the important questions that astrobiology seeks to answer. A truly interdisciplinary endeavor, astrobiology looks at the evidence of astronomy, biology, physics, chemistry, and a host of other fields. A grand narrative emerges, beginning from the smallest, most common particles yet producing amazing complexity and order. Lucas Mix is a congenial guide through the depths of astrobiology, exploring how the presence of planets around other stars affects our knowledge of our own; how water, carbon, and electrons interact to form life as we know it; and how the processes of evolution and entropy act upon every living thing. This book also reveals that our understanding and our context are deeply intertwined. It shows how much astrobiology can tell us about who we are—as a planet, as a species, and as individuals. "This book: Provides extensive grounding in key issues of astrophysics, chemistry, biology and geophysics; over 150 images and illustrations; exercises for each chapter, ranging from straightforward calculation problems to more far-ranging research-oriented exercises; an online component for users that includes new exercises and a continually updated blog of late-breaking scientific news items, fully cross referenced with the book; and extensive bibliographies for each chapter."--BOOK JACKET. Extraterrestrial life is a common theme in science fiction, but is it a serious prospect in the real world? Astrobiology is the emerging field of science that seeks to answer this question. The possibility of life elsewhere in the cosmos is one of the most profound subjects that human beings can ponder. Astrophysicist Andrew May gives an expert overview of our current state of knowledge, looking at how life started on Earth, the tell-tale 'signatures' it produces, and how such signatures might be detected elsewhere in the Solar System or on the many 'exoplanets' now being discovered by the Kepler and TESS missions. Along the way the book addresses key questions such as the riddle of Fermi's paradox ('Where is everybody?') and the crucial role of DNA and water – they're essential to 'life as we know it', but is the same true of alien life? And the really big question: when we eventually find extraterrestrials, will they be friendly or hostile? This book implements several outstanding features which are helpful to the general reader. It is organized in the form of a ‘Questions and Answers’ guide, an approach unique in the field of astrobiology. The questions and answers are linked in a conversation-like style, with each new question following from the previous answer. The book is organized into 20 chapters discussing broad and comprehensive topics, with over 250 questions answered. While the book is written for general readers who are assumed to have an interest in science, though not necessarily an extensive background, it will also be helpful to the beginning student and those who wish to pursue further one or more aspects of the field. It provides the reader with a comprehensive set of ‘Further Readings.’ After each chapter, resource material is keyed to the individual answers to each question. At the end of the book, full references are given, as well as a guide for how to obtain them. A thorough Index is also provided. The streamlined, condensed, and yet comprehensive approach provided here is well-suited for stimulating the appetite of many readers for delving more into the fascinating and multi-faceted field of astrobiology. An in-depth view of the panspermia hypothesis examined against the latest knowledge of planetary formation and related processes. Panspermia is the concept that life can be passively transported through space on various bodies and seed, habitable planets and moons, which we are beginning to learn may exist in large numbers. It is an old idea, but not popular with those who prefer that life on Earth started on Earth, an alternative, also unproven hypothesis. This book updates the concept of panspermia in the light of new evidence on planet formation, molecular clouds, solar system motions, supernovae ejection mechanisms, etc. Thus, it is to be a book about newly understood prospects for the movement of life through space. The novel approach presented in this book gives new insights into the panspermia theory and its connection with planetary formation and the evolution of galaxies. This offers a good starting point for future research proposals about exolife and a better perspective for empirical scrutiny of panspermia theory. Also, the key to understanding life in the universe is to understand that the planetary formation process is convolved with the evolution of stellar systems in their galactic environment. The book provides the synthesis of all these elements and gives the readers an up-to-date insight on how panspermia might fit into the big picture. Audience Given the intrinsic interdisciplinary nature of the panspermia hypothesis the book will have a wide audience across various scientific disciplines covering astronomy, biology, physics and chemistry. Apart from scientists, the book will appeal to engineers who are involved in planning and realization of future space missions. "This book focuses on the emerging scientific discipline of astrobiology, exploring the humanistic issues of this multidisciplinary field. To be sure, there are myriad scientific questions that astrobiologists have only begun to address. However, this is not a purely scientific enterprise. More research on the broader social and conceptual aspects of astrobiology is needed. Just what are our ethical obligations towards different sorts of alien

life? Should we attempt to communicate with life beyond our planet? What is "life" in the most general sense? The current volume addresses these questions by looking at different perspectives from philosophers, historians, theologians, social scientists, and legal scholars. It sets a benchmark for future work in astrobiology, giving readers the groundwork from which to base the continuous scholarship coming from this ever-growing scientific field"-- The data in this book are new or updated, and will serve also as Origin of Life and evolutionary studies. Endospores of bacteria have a long history of use as model organisms in astrobiology, including survival in extreme environments and interplanetary transfer of life. Numerous other bacteria as well as archaea, lichens, fungi, algae and tiny animals (tardigrades, or water bears) are now being investigated for their tolerance to extreme conditions in simulated or real space environments. Experimental results from exposure studies on the International Space Station and space probes for up to 1.5 years are presented and discussed. Suggestions for extaterrestrial energy sources are also indicated. Audience Researchers and graduate students in microbiology, biochemistry, molecular biology and astrobiology, as well as anyone interested in the search for extraterrestrial life and its technical preparations. An understanding of the unique conditions that allowed life to emerge and exist today on our planet is essential if we are to answer two fundamental questions facing humanity - the continuation of life on earth, and the existence of life outside our planet. This book contributes to our understanding of astrobiology as it applies to planet Earth. Compelling account of how ideas of alien life have evolved for general readers, amateur astronomers and undergraduate students studying astrobiology. This book provides concise and cutting-edge reviews in astrobiology, a young and still emerging multidisciplinary field of science that addresses the fundamental questions of how life originated and diversified on Earth, whether life exists beyond Earth, and what is the future for life on Earth. Readers will find coverage of the latest understanding of a wide range of fascinating topics, including, for example, solar system formation, the origins of life, the history of Earth as revealed by geology, the evolution of intelligence on Earth, the implications of genome data, insights from extremophile research, and the possible existence of life on other planets within and beyond the solar system. Each chapter contains a brief summary of the current status of the topic under discussion, sufficient references to enable more detailed study, and descriptions of recent findings and forthcoming missions or anticipated research. Written by leading experts in astronomy, planetary science, geoscience, chemistry, biology, and physics, this insightful and thought-provoking book will appeal to all students and scientists who are interested in life and space. When the space exploration initiative was announced, Congress asked the NRC to review the science NASA proposed to carryout under the initiative. It also asked the NRC to assess whether this program would provide balanced scientific research across the established disciplines supported by NASA in addition to supporting the new initiative. In 2005, the NRC released three studies focusing on a portion of that task, but changes at NASA forced the postponement of the last phase. This report presents that last phase with an assessment of the health of the NASA scientific disciplines under the budget requests imposed by the exploration initiative. The report also provides an analysis of whether the science budget appropriately reflects cross-disciplinary scientific priorities. Astrobiology is an interdisciplinary field that asks profound scientific questions. How did life originate on the Earth? How has life persisted on the Earth for over three billion years? Is there life elsewhere in the Universe? What is the future of life on Earth? Astrobiology: Understanding Life in the Universe is an introductory text which explores the structure of living things, the formation of the elements for life in the Universe, the biological and geological history of the Earth and the habitability of other planets in our own Solar System and beyond. The book is designed to convey some of the major conceptual foundations in astrobiology that cut across a diversity of traditional fields including chemistry, biology, geosciences, physics and astronomy. It can be used to complement existing courses in these fields or as a stand-alone text for astrobiology courses. Readership: Undergraduates studying for degrees in earth or life sciences, physics, astronomy and related disciplines, as well as anyone with an interest in grasping some of the major concepts and ideas in astrobiology. Examines the origins of life on Earth and the search for extraterrestrial life, through an understanding of the factors that have allowed life to exist on this planet and the commonalities on others that may enable life elsewhere. Three recent developments have greatly increased interest in the search for life on Mars. The first is new information about the Martian environment including evidence of a watery past and the possibility of atmospheric methane. The second is the possibility of microbial viability on Mars. Finally, the Vision for Space Exploration initiative included an explicit directive to search for the evidence of life on Mars. These scientific and political developments led NASA to request the NRCâ€™s assistance in formulating an up-to-date integrated astrobiology strategy for Mars exploration. Among other topics, this report presents a review of current knowledge about possible life on Mars; an astrobiological assessment of current Mars missions; a review of Mars-mission planetary protection; and findings and recommendations. The report notes that the greatest increase in understanding of Mars will come from the collection and return to Earth of a well-chosen suite of Martian surface materials. This book aims to contribute significantly to the understanding of issues of value (including the ultimate value of space-related activities) which repeatedly emerge in interdisciplinary discussions on space and society. Although a recurring feature of discussions about space in the humanities, the treatment of value questions has tended to be patchy, of uneven quality and even, on occasion, idiosyncratic rather than drawing upon a close familiarity with state-of-the-art ethical theory. One of the volume's aims is to promote a more robust and theoretically informed approach to the ethical dimension of discussions on space and society. While the contributions are written in a manner which is accessible across disciplines, the book still withstands scrutiny by those whose work is primarily on ethics. At the same time it allows academics across a range of disciplines an insight into current approaches toward how the work of ethics gets done. The issues of value raised could be used to inform debates about regulation, space law and protocols for microbial discovery as well as longer-range policy debates about funding. The past decade has seen a remarkable revolution in genomic research, the discoveries of extreme environments in which organisms can live and even flourish on Earth, the identification of past and possibly present liquid-water environments in our solar system, and the detection of planets around other stars. Together these accomplishments bring us much closer to understanding the origin of life, its evolution and diversification on Earth, and its occurrence and distribution in the cosmos. A new multidisciplinary program called Astrobiology was initiated in 1997 by the National Aeronautics and Space Administration (NASA) to foster such research and to make available additional resources for individual and consortium-based efforts. Other agencies have also begun new programs to address the origin, evolution, and cosmic distribution of life. Five years into the Astrobiology program, it is appropriate to assess the scientific and programmatic impacts of these initiatives. Edward J. Weiler, NASA's associate administrator for the Office of Space Science, tasked the Committee on the Origins and Evolution of Life (COEL) with assessing the state of NASA's Astrobiology program. The search for life is one of the most active fields in space science and involves a wide variety of scientific disciplines, including planetary science, astronomy and

astrophysics, chemistry, biology, chemistry, and geoscience. In December 2016, the Space Studies Board hosted a workshop to explore the possibility of habitable environments in the solar system and in exoplanets, techniques for detecting life, and the instrumentation used. This publication summarizes the presentations and discussions from the workshop. This volume on astrobiology of the Springer Briefs in Life Sciences book series addresses the three fundamental questions on origin, evolution, distribution and future of life in the universe: how does life begin and evolve? Is there life beyond Earth and, if so, how can we detect it? What is the future of life on Earth and in the universe? The book provides insights into astrobiological experiments that are being performed on the International Space Station, ISS, and discusses their findings. This extremely exciting volume on astrobiology is intended for scientists of various research fields and for laypersons interested in space research and in the fundamental issues of the universe and life. The Living Universe is a comprehensive, historically nuanced study of the formation of the new scientific discipline of exobiology and its transformation into astrobiology. Among many other themes, the authors analyze how research on the origin of life became wedded to the search for life on other planets and for extraterrestrial intelligence. Many scientific breakthroughs of the last forty years were either directly supported or indirectly spun off from NASA's exobiology program, including cell symbiosis, the discovery of the Archaea, and the theories of Nuclear Winter and the asteroid extinction of the dinosaurs. Exobiology and astrobiology have generated public fascination, enormous public relations benefits for NASA, and--on the flip side of the coin--some of the most heated political wrangling ever seen in government science funding. Dick and Strick providea riveting overview of the search for life throughout the universe, with all of the Earthly complexities of a science-in-the-making and the imperfect humans called scientists. Their book will appeal to biologists, historians and philosophers of science, planetary scientists (including geologists), and an educated general readership interested in the investigation of life on other planets. The dynamic field of astrochemistry brings together ideas of physics, astrophysics, biology and chemistry to the study of molecules between stars, around stars and on planets. Astrochemistry: from Astronomy to Astrobiology provides a clear and concise introduction to this rapidly evolving multidisciplinary subject. Starting with the Molecular Universe, the text covers the formation of the elements, simple models of stars and their classification. It then moves on to draw on the theme of the Origins of Life to study interstellar chemistry, meteorite and comet chemistry as well as the chemistry of planets. Prebiotic chemistry and astrobiology are explored by examining the extremes of the biosphere on Earth, seeing how this may be applied to life in other solar systems. Astrochemsitry assumes a basic familiarity with principles of physical and organic chemistry but no prior knowledge of biology or astrophysics. This innovative text incorporates results from the latest research and ground and space missions, with key images enhanced by a colour plate section. includes latest research and results from ground and space missions colour plate section summary of concepts and calculations at the end of each chapter accompanying website www.wiley.co/go/shawastrochemistry This book will be an ideal text for an undergraduate course in Astrochemistry and an essential tool for postgraduates entering the field. This study discusses the publicly available studies of future flagship- and New Frontiers-class missions NASA initiated since the completion of Vision and Voyages. The report considers the priority areas as defined in Vision and Voyages where publicly available mission studies have not been undertaken; appropriate mechanisms by which mission-study gaps might be filled in the near- to mid-term future; and other activities that might be undertaken in the near- to mid-term future to optimize and/or expedite the work of the next planetary science decadal survey committee. An exploration of how acceptance of panspermia will soon change history • Offers extensive scientific proof of panspermia--that life arose on Earth via comets and that evolution is seeded by viruses arriving via comets and interstellar dust • Explores the major philosophical, psychological, cultural, religious, and environmental ramifications of the acceptance of this new scientific worldview Mainstream consensus is that life arose on Earth spontaneously out of “primordial soup.” Yet this theory, as well as the Darwinian “survival of the fittest” concept as it relates to major steps in evolution, has no scientific basis or proof. Where, then, did life come from? As the authors show, with conclusive scientific evidence, life came from space--a concept known as “panspermia.” We humans, and all other life on Earth, evolved over millennia in response to viruses that arrived via comets, and we continue to do so. Exploring the philosophical, psychological, cultural, and environmental ramifications of the acceptance of panspermia, the authors show how the shift will be on par with the Copernican Revolution--when it was finally accepted that the Earth was not the center of the Universe. Explaining the origins of the panspermia theory in the work of the late Sir Fred Hoyle, the authors reveal the vast body of evidence that has accumulated over the past 4 decades in favor of the cosmic origins of life, including viral inserts found in DNA that have shaped our human genome over millions of years. They show how the tiniest of viruses, microscopic animals (tardigrades), and even seeds have been found to be natural cosmonauts. The authors also show how space-borne viruses play a crucial role in the positive evolution of life and that our entire existence on this planet is contingent on the continuing ingress of cosmic viruses. Revealing how panspermia offers answers to some of humanity’s longstanding questions about the origins of life, the authors discuss the impact this shift in understanding will have on our relationship with the Earth and on culture, history, and religion. And perhaps the most dramatic ramification of all is that acceptance of panspermia means acceptance that Earth is not unique--that other life-filled planets exist and intelligent life is common in the Universe. Not only did we come from space, but we are not alone. An astronomer explores the science of astrobiology in this “serious but accessible examination of the prospects for finding life elsewhere in the universe” (Sean Carroll, author of The Big Picture). Describing the most recent discoveries made with space exploration technology, including the Kepler space telescope, the Mars Curiosity rover, and the New Horizons probe, astronomer Jon Willis asks readers to consider five possible scenarios for finding extraterrestrial life. He reviews what we know and don’t know about the life-sustaining potential of Mars’s subsoil ice and the water-ice moons Europa and Enceladus. He also looks at Saturn’s moon Titan through the lens of our own planet’s ancient past. In this concise yet far-reaching volume, Willis even looks beyond our solar system, investigating the top candidates for a “second Earth” in a myriad of exoplanets. “Through humorous, concise, accessible writing, Willis eloquently presents the growing—though still circumstantial—evidence that we are not alone."—Publishers Weekly (starred review) Introducing new, multidisciplinary concepts, this book explains how we have reached a critical threshold in the study of astrobiology.

- Complete Course In Astrobiology
- Science Society And The Search For Life In The Universe
- Astrobiology And Space Medicine
- Searching For Life Across Space And Time
- Astrobiology
- Astrobiology Discovery And Societal Impact
- An Astrobiology Strategy For The Search For Life In The Universe
- Space Time And Aliens
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