

Books Physics For The Life Sciences Zinke Allmang 1

How Things Work provides an accessible introduction to physics for the non-science student. Like the previous editions it employs everyday objects, with which students are familiar, in case studies to explain the most essential physics concepts of day-to-day life. Lou Bloomfield takes seemingly highly complex devices and strips away the complexity to show how at their heart are simple physics ideas. Once these concepts are understood, they can be used to understand the behavior of many devices encountered in everyday life. The sixth edition uses the power of WileyPLUS Learning Space with Orion to give students the opportunity to actively practice the physics concepts presented in this edition. This text is an unbound, three hole punched version. Access to WileyPLUS sold separately.

The New York Times bestseller from the author of *The Order of Time and Reality Is Not What It Seems* and *Helgoland* “One of the year’s most entrancing books about science.”—The Wall Street Journal “Clear, elegant...a whirlwind tour of some of the biggest ideas in physics.”—The New York Times Book Review This playful, entertaining, and mind-bending introduction to modern physics briskly explains Einstein's general relativity, quantum mechanics, elementary particles, gravity, black holes, the complex architecture of the universe, and the role humans play in this weird and wonderful world. Carlo Rovelli, a renowned theoretical physicist, is a delightfully poetic and philosophical scientific guide. He takes us to the frontiers of our knowledge: to the most minute reaches of the fabric of space, back to the origins of the cosmos, and into the workings of our minds. The book celebrates the joy of discovery. “Here, on the edge of what we know, in contact with the ocean of the unknown, shines the mystery and the beauty of the world,” Rovelli writes. “And it’s breathtaking.”

This full-colour undergraduate textbook, based on a two semester course, presents the fundamentals of biological physics, introducing essential modern topics that include cells, polymers, polyelectrolytes, membranes, liquid crystals, phase transitions, self-assembly, photonics, fluid mechanics, motility, chemical kinetics, enzyme kinetics, systems biology, nerves, physiology, the senses, and the brain. The comprehensive coverage, featuring in-depth explanations of recent rapid developments, demonstrates this to be one of the most diverse of modern scientific disciplines. *The Physics of Living Processes: A Mesoscopic Approach* is comprised of five principal sections: • Building Blocks • Soft Condensed Matter Techniques in Biology • Experimental Techniques • Systems Biology • Spikes, Brains and the Senses The unique focus is predominantly on the mesoscale — structures on length scales between those of atoms and the macroscopic behaviour of whole organisms. The connections between molecules and their emergent biological phenomena provide a novel integrated perspective on biological physics, making this an important text across a variety of scientific disciplines including biophysics, physics, physical chemistry, chemical engineering and bioengineering. An extensive set of worked tutorial questions are included, which will equip the reader with a range of new physical tools to approach problems in the life sciences from medicine, pharmaceutical science and agriculture.

This comprehensive and extensively classroom-tested biophysics textbook is a complete introduction to the physical principles

underlying biological processes and their applications to the life sciences and medicine. The foundations of natural processes are placed on a firm footing before showing how their consequences can be explored in a wide range of biosystems. The goal is to develop the readers intuition, understanding, and facility for creative analysis that are frequently required to grapple with problems involving complex living organisms. Topics cover all scales, encompassing the application of statics, fluid dynamics, acoustics, electromagnetism, light, radiation physics, thermodynamics, statistical physics, quantum biophysics, and theories of information, ordering, and evolutionary optimization to biological processes and bio-relevant technological implementations. Sound modeling principles are emphasized throughout, placing all the concepts within a rigorous framework. With numerous worked examples and exercises to test and enhance the readers understanding, this book can be used as a textbook for physics graduate students and as a supplementary text for a range of premedical, biomedical, and biophysics courses at the undergraduate and graduate levels. It will also be a useful reference for biologists, physicists, medical researchers, and medical device engineers who want to work from first principles.

The College Physics for AP(R) Courses text is designed to engage students in their exploration of physics and help them apply these concepts to the Advanced Placement(R) test. This book is Learning List-approved for AP(R) Physics courses. The text and images in this book are grayscale.

An empowering new view of the nature of physics and the constant evolution of our physical and social world
In our world today, scientists and technologists speak one language of reality. Everyone else, whether they be prime ministers, lawyers, or primary school teachers speak an outdated Newtonian language of reality. While Newton saw time and space as rigid and absolute, Einstein showed that time is relative – it depends on height and velocity – and that space can stretch and distort. The modern Einsteinian perspective represents a significant paradigm shift compared with the Newtonian paradigm that underpins most of the school education today. Research has shown that young learners quickly access and accept Einsteinian concepts and the modern language of reality. Students enjoy learning about curved space, photons, gravitational waves, and time dilation; often, they ask for more! A consistent education within the Einsteinian paradigm requires rethinking of science education across the entire school curriculum, and this is now attracting attention around the world. This book brings together a coherent set of chapters written by leading experts in the field of Einsteinian physics education. The book begins by exploring the fundamental concepts of space, time, light, and gravity and how teachers can introduce these topics at an early age. A radical change in the curriculum requires new learning instruments and innovative instructional approaches. Throughout the book, the authors emphasise and discuss evidence-based approaches to Einsteinian concepts, including computer- based tools, geometrical methods, models and analogies, and simplified mathematical treatments. Teaching Einsteinian Physics in Schools is designed as a resource for teacher education students, primary and secondary science teachers, and for anyone interested in a scientifically accurate description of physical reality at a level appropriate for school education.

For the past fifteen years, acclaimed science writer Margaret Wertheim has been collecting the works of "outsider physicists,"

many without formal training and all convinced that they have found true alternative theories of the universe. Jim Carter, the Einstein of outsiders, has developed his own complete theory of matter and energy and gravity that he demonstrates with experiments in his backyard,-with garbage cans and a disco fog machine he makes smoke rings to test his ideas about atoms. Captivated by the imaginative power of his theories and his resolutely DIY attitude, Wertheim has been following Carter's progress for the past decade. Centuries ago, natural philosophers puzzled out the laws of nature using the tools of observation and experimentation. Today, theoretical physics has become mathematically inscrutable, accessible only to an elite few. In rejecting this abstraction, outsider theorists insist that nature speaks a language we can all understand. Through a profoundly human profile of Jim Carter, Wertheim's exploration of the bizarre world of fringe physics challenges our conception of what science is, how it works, and who it is for.

A groundbreaking argument for why alien life will evolve to be much like life here on Earth We are all familiar with the popular idea of strange alien life wildly different from life on earth inhabiting other planets. Maybe it's made of silicon! Maybe it has wheels! Or maybe it doesn't. In *The Equations of Life*, biologist Charles S. Cockell makes the forceful argument that the laws of physics narrowly constrain how life can evolve, making evolution's outcomes predictable. If we were to find on a distant planet something very much like a lady bug eating something like an aphid, we shouldn't be surprised. The forms of life are guided by a limited set of rules, and as a result, there is a narrow set of solutions to the challenges of existence. A remarkable scientific contribution breathing new life into Darwin's theory of evolution, *The Equations of Life* makes a radical argument about what life can--and can't--be.

Reveals how recurring patterns in nature are accounted for by a single governing principle of physics, explaining how all designs in the world from biological life to inanimate systems evolve in a sequence of ever-improving designs that facilitate flow.

"University Physics for the Life Sciences has been written in response to the growing call for an introductory physics course explicitly designed for the needs and interests of life science students anticipating a career in biology, medicine, or a health-related field"--

The purpose of the book is to give a survey of the physics that is relevant for biological applications, and also to discuss what kind of biology needs physics. The book gives a broad account of basic physics, relevant for the applications and various applications from properties of proteins to processes in the cell to wider themes such as the brain, the origin of life and evolution. It also considers general questions of common interest such as reductionism, determinism and randomness, where the physics view often is misunderstood. The subtle balance between order and disorder is a repeated theme appearing in many contexts. There are descriptive parts which shall be sufficient for the comprehension of general ideas, and more detailed, formalistic parts for those who want to go deeper, and see the ideas expressed in terms of mathematical formulas. - Describes how physics is needed for understanding basic principles of biology - Discusses the delicate balance between order and disorder in living systems - Explores how physics play a role high biological functions, such as learning and thinking "Fundamentals might be the perfect book for the winter of this plague year. . . . Wilczek writes with breathtaking economy and clarity, and his pleasure in his subject is palpable." —The New York Times Book Review One of our great contemporary scientists reveals the ten profound insights that illuminate what everyone should know about the physical world In *Fundamentals*, Nobel laureate Frank Wilczek offers the reader a simple yet profound exploration of reality based on the deep revelations of modern science. With clarity and an infectious sense of joy, he guides us through the essential concepts that form our understanding of what the world is and how it works. Through these pages, we come

to see our reality in a new way--bigger, fuller, and stranger than it looked before. Synthesizing basic questions, facts, and dazzling speculations, Wilczek investigates the ideas that form our understanding of the universe: time, space, matter, energy, complexity, and complementarity. He excavates the history of fundamental science, exploring what we know and how we know it, while journeying to the horizons of the scientific world to give us a glimpse of what we may soon discover. Brilliant, lucid, and accessible, this celebration of human ingenuity and imagination will expand your world and your mind.

"What Is Life?" is Nobel laureate Erwin Schrödinger's exploration of the question which lies at the heart of biology. His essay, "Mind and Matter," investigates what place consciousness occupies in the evolution of life, and what part the state of development of the human mind plays in moral questions. "Autobiographical Sketches" offers a fascinating fragmentary account of his life as a background to his scientific writings.

Isaac Newton was as strange as he was intelligent. In a few short years, he made astounding discoveries in physics, astronomy, optics, and mathematics— yet never told a soul. Though isolated, snobbish, and jealous, he almost single-handedly changed the course of scientific advancement and ushered in the Enlightenment. Newton invented the refracting telescope, explained the motion of planets and comets, discovered the multicolored nature of light, and created an entirely new field of mathematical understanding: calculus. The world might have been a very different place had Newton's theories and observations not been coaxed out of him by his colleagues. Isaac Newton and Physics for Kids paints a rich portrait of this brilliant and complex man, including 21 hands-on projects that explore the scientific concepts Newton developed and the times in which he lived. Readers will build a simple waterwheel, create a 17th-century plague mask, track the phases of the moon, and test Newton's Three Laws of Motion using coins, a skateboard, and a model boat they construct themselves. The text includes a time line, online resources, and reading list for further study. And through it all, readers will learn how the son of a Woolsthorpe sheep farmer grew to become the most influential physicist in history.

This book aims to demystify fundamental biophysics for students in the health and biosciences required to study physics and to understand the mechanistic behaviour of biosystems. The text is well supplemented by worked conceptual examples that will constitute the main source for the students, while combining conceptual examples and practice problems with more quantitative examples and recent technological advances.

A compilation of previously unpublished lectures delivered at the International Centre for Theoretical Physics by the pioneers and creators of modern physics --Bethe, Dirac, Heisenberg, Wigner, Klein and Landau (the sixth delivered by E Lifshitz). By sharing with us their own lives of physics, these outstanding physicists convey the sense of total dedication, the pleasure and elegance of scientific creation at its peak. Readers would acquire a deeper sense of the scope and nature of physics, and the insights of its fascinating diverse disciplines as the developments of modern physics are being unfolded through history. Contents:Foreword: Twenty-One Years After (Abdus Salam)Energy on Earth and in the Stars (H A Bethe)Methods in Theoretical Physics (P A M Dirac)Theory, Criticism and a Philosophy (W Heisenberg)The Scientist and Society (E P Wigner)From My Life of Physics (O Klein)Landau-Great Scientist and Teacher (tribute by E M Lifshitz) Readership: Physicists.

Each chapter has three types of learning aides for students: open-ended questions, multiple-choice questions, and quantitative problems. There is an average of about 50 per chapter. There are also a number of worked examples in the chapters, averaging

over 5 per chapter, and almost 600 photos and line drawings.

For decades, neuroscientists, psychologists, and an army of brain researchers have been struggling, in vain, to explain the phenomenon of consciousness. Now there is a clear trail to the answer, and it leads through the dense jungle of quantum physics, Zen, and subjective experience, and arrives at an unexpected destination. In this tour-de-force of scientific investigation, Evan Harris Walker, a pioneer in the science of consciousness, describes the outcome of his fifty-year search for the true nature of reality. Drawing on a deep knowledge of quantum physics and Zen philosophy, Walker shows how the operation of bizarre yet actual properties of elementary particles support a new and exciting theory of reality, based on the principles of quantum physics; a theory that answers questions such as “What is the nature of consciousness, of will?” “What is the source of material reality?” and “What is God?” Clearly written in non-technical, lyrical prose, *The Physics of Consciousness* is more than just the explanation of a science—it is a new vision of life.

This text blends traditional introductory physics topics with an emphasis on human applications and an expanded coverage of modern physics topics, such as the existence of atoms and the conversion of mass into energy. Topical coverage is combined with the author's lively, conversational writing style, innovative features, the direct and clear manner of presentation, and the emphasis on problem solving and practical applications.

Taking readers inside the classrooms and minds of these giants of modern science, Moffat affectionately exposes the foibles and eccentricities of famous physicists, as they worked on the revolutionary ideas that, today, are the very foundation of modern physics and cosmology.

The animal world is full of mysteries. Why do dogs slurp from their drinking bowls while cats lap up water with a delicate flick of the tongue? How does a tiny turtle hatchling from Florida circle the entire northern Atlantic before returning to the very beach where it hatched? And how can a Komodo dragon kill a water buffalo with a bite only as strong as a domestic cat's? These puzzles – and many more besides – are all explained by physics. From heat and light to electricity and magnetism, *Furry Logic* unveils the ways that more than 30 animals exploit physics to eat, drink, mate and dodge death in their daily battle for survival. Along the way, science journalists Martin Durrani and Liz Kalaugher introduce the great physicists whose discoveries helped us understand the animal world, as well as the animal experts of today who are scouring the planet to find and study the animals that seem to push the laws of physics to the limit. Presenting mind-bending physics principles in a simple and engaging way, *Furry Logic* will appeal both to animal lovers and to those curious to see how physics crops up in the natural world. It's more of a 'howdunit' than a whodunit, though you're unlikely to guess some of the answers.

A thoroughly updated and extended new edition of this well-regarded introduction to the basic concepts of biological physics for students in the health and life sciences. Designed to provide a solid foundation in physics for students following health science courses, the text is divided into six sections: Mechanics, Solids and Fluids, Thermodynamics, Electricity and DC Circuits, Optics, and Radiation and Health. Filled with illustrative examples, *Introduction to Biological Physics for the Health and Life Sciences*,

Second Edition features a wealth of concepts, diagrams, ideas and challenges, carefully selected to reference the biomedical sciences. Resources within the text include interspersed problems, objectives to guide learning, and descriptions of key concepts and equations, as well as further practice problems. NEW CHAPTERS INCLUDE: Optical Instruments Advanced Geometric Optics Thermodynamic Processes Heat Engines and Entropy Thermodynamic Potentials This comprehensive text offers an important resource for health and life science majors with little background in mathematics or physics. It is also an excellent reference for anyone wishing to gain a broad background in the subject. Topics covered include: Kinematics Force and Newton's Laws of Motion Energy Waves Sound and Hearing Elasticity Fluid Dynamics Temperature and the Zeroth Law Ideal Gases Phase and Temperature Change Water Vapour Thermodynamics and the Body Static Electricity Electric Force and Field Capacitance Direct Currents and DC Circuits The Eye and Vision Optical Instruments Atoms and Atomic Physics The Nucleus and Nuclear Physics Ionising Radiation Medical imaging Magnetism and MRI Instructor's support material available through companion website, www.wiley.com/go/biological_physics

"[Czerski's] quest to enhance humanity's everyday scientific literacy is timely and imperative."—Science Storm in a Teacup is Helen Czerski's lively, entertaining, and richly informed introduction to the world of physics. Czerski provides the tools to alter the way we see everything around us by linking ordinary objects and occurrences, like popcorn popping, coffee stains, and fridge magnets, to big ideas like climate change, the energy crisis, or innovative medical testing. She provides answers to vexing questions: How do ducks keep their feet warm when walking on ice? Why does it take so long for ketchup to come out of a bottle? Why does milk, when added to tea, look like billowing storm clouds? In an engaging voice at once warm and witty, Czerski shares her stunning breadth of knowledge to lift the veil of familiarity from the ordinary.

At last, science and the soul shake hands. Writing in a style that is both lucid and charming, mischievous and profound, Dr. Amit Goswami uses the language and concepts of quantum physics to explore and scientifically prove metaphysical theories of reincarnation and immortality. In *Physics of the Soul*, Goswami helps readers understand the perplexities of the quantum physics model of reality and the perennial beliefs of spiritual and religious traditions. He shows how they are not only compatible but also provide essential support for each other. The result is a deeply broadened, exciting, and enriched worldview that integrates mind and spirit into science. Includes a new preface.

Based on lectures by the author, this volume is designed as a textbook on general ultrasonics. The text provides coverage of the propagation of ultrasonic waves in media with different elastic properties and under conditions close to those encountered in scientific and practical applications of ultrasound.

This third edition covers topics in physics as they apply to the life sciences, specifically medicine, physiology, nursing and other applied health fields. It includes many figures, examples and illustrative problems and appendices which provide convenient access to the most important concepts of mechanics, electricity, and optics.

Traces the life of a Jewish physicist who had to flee Nazi Germany, codiscovered nuclear fission with Otto Hahn and Fritz Strassmann, but was denied recognition when the work received a Nobel Prize

Explore the laws and theories of physics in this accessible introduction to the forces that shape our universe, our planet, and our everyday lives. Using a bold, graphics-led approach, *The Physics Book* sets out more than 80 of the key concepts and discoveries that have defined the subject and influenced our technology since the beginning of time. With the focus firmly on unpacking the thought behind each theory—as well as exploring when and how each idea and breakthrough came about—five themed chapters examine the history and developments in specific areas such as Light, Sound, and Electricity. Eureka moments abound: from Archimedes' bathtub discoveries about displacement and density, and Galileo's experiments with spheres falling from the Tower of Pisa, to Isaac Newton's apple and his conclusions about gravity and the laws of motion. You'll also learn about Albert Einstein's revelations about relativity; how the accidental discovery of cosmic microwave background radiation confirmed the Big Bang theory; the search for the Higgs boson particle; and why most of the universe is missing. If you've ever wondered exactly how physicists formulated—and proved—their abstract concepts, *The Physics Book* is the book for you. Series Overview: *Big Ideas Simply Explained* series uses creative design and innovative graphics along with straightforward and engaging writing to make complex subjects easier to understand. With over 7 million copies worldwide sold to date, these award-winning books provide just the information needed for students, families, or anyone interested in concise, thought-provoking refreshers on a single subject.

Setting aside the pervasive material bias of science and lifting the obscuring fog of religious sectarianism reveals a surprisingly clear unity of science and religion. The explanations of transcendent phenomena given by saints, sages, and near-death experiencers—miracles, immortality, heaven, God, and transcendent awareness—are fully congruent with scientific discoveries in the fields of relativity, quantum physics, medicine, M-theory, neuroscience, and quantum biology. *The Physics of God* describes the intersections of science and religion with colorful, easy-to-understand metaphors, making abstruse subjects within both science and religion easily accessible to the layman—no math, no dogma. This intriguing book: Pulls back the curtain on the light-show illusion we call matter. Connects string theory's hidden brane worlds to religion's transcendent heavens. Reveals the scientific secret of life and immortality: quantum biology's startling discovery that the human body is continuously entangled. Demonstrates the miracle-making power of our minds to effect instantaneous physiological changes. Explains how the intelligent observer effect confirms our high spiritual potential. Compelling and concise, *The Physics of God* will make you believe in the unity of science and religion and eager to experience the personal transcendence that is the promise of both.

Physics of Life
The Physicist's Road to Biology
Elsevier

The Physics of Life explores the roots of the big question by examining the deepest urges and properties of living things, both animate and inanimate: how to live longer, with food, warmth, power, movement and free access to other people and surroundings. Bejan explores controversial and relevant issues such as sustainability, water and food supply, fuel, and economy, to critique the state in which the world understands positions of power and freedom. Breaking down concepts such as desire and power, sports health and culture, the state of economy, water and energy, politics and distribution, Bejan uses the language of physics to explain how each system works in order to clarify the meaning of evolution in its broadest scientific sense, moving the reader towards a better understanding of the world's systems and the natural evolution of cultural and political development. The Physics of Life argues that the evolution phenomenon is much broader and older than the evolutionary designs that constitute the biosphere, empowering readers with a new view of the globe and the future, revealing that the urge to have better ideas has the same physical effect as the urge to have better laws and better government. This is evolution explained loudly but also elegantly, forging a path that flows sustainability.

"Explanations about the extraordinary physics that invisibly guides our daily lives"--

Imagine, if you can, the world in the year 2100. In *Physics of the Future*, Michio Kaku—the New York Times bestselling author of *Physics of the Impossible*—gives us a stunning, provocative, and exhilarating vision of the coming century based on interviews with over three hundred of the world's top scientists who are already inventing the future in their labs. The result is the most authoritative and scientifically accurate description of the revolutionary developments taking place in medicine, computers, artificial intelligence, nanotechnology, energy production, and astronautics. In all likelihood, by 2100 we will control computers via tiny brain sensors and, like magicians, move objects around with the power of our minds. Artificial intelligence will be dispersed throughout the environment, and Internet-enabled contact lenses will allow us to access the world's information base or conjure up any image we desire in the blink of an eye. Meanwhile, cars will drive themselves using GPS, and if room-temperature superconductors are discovered, vehicles will effortlessly fly on a cushion of air, coasting on powerful magnetic fields and ushering in the age of magnetism. Using molecular medicine, scientists will be able to grow almost every organ of the body and cure genetic diseases. Millions of tiny DNA sensors and nanoparticles patrolling our blood cells will silently scan our bodies for the first sign of illness, while rapid advances in genetic research will enable us to slow down or maybe even reverse the aging process, allowing human life spans to increase dramatically. In space, radically new ships—needle-sized vessels using laser propulsion—could replace the expensive chemical rockets of today and perhaps visit nearby stars. Advances in nanotechnology may lead to the fabled space elevator, which would propel humans hundreds of miles above the earth's atmosphere at the push of a button. But

these astonishing revelations are only the tip of the iceberg. Kaku also discusses emotional robots, antimatter rockets, X-ray vision, and the ability to create new life-forms, and he considers the development of the world economy. He addresses the key questions: Who are the winner and losers of the future? Who will have jobs, and which nations will prosper? All the while, Kaku illuminates the rigorous scientific principles, examining the rate at which certain technologies are likely to mature, how far they can advance, and what their ultimate limitations and hazards are. Synthesizing a vast amount of information to construct an exciting look at the years leading up to 2100, *Physics of the Future* is a thrilling, wondrous ride through the next 100 years of breathtaking scientific revolution.

Stanley Deser is a preeminent theoretical physicist who made monumental contributions to general relativity, quantum field theory and high energy physics; he is a co-creator of supergravity. This is his personal story, intended for a broad, scientifically curious audience, with emphasis on the historic figures that defined the modern aspects of the field. Beginning with an account of his early life in Europe during the fateful period leading up to WW2, it continues with his family's dramatic escape from the Nazis through their arrival to the US. His education at public institutions including Brooklyn College nurtured his love of physics from an early age. He earned his PhD at Harvard and spent fruitful postdoc years at the Institute for Advanced Study and the Niels Bohr Institute, where he met many of the luminaries of the field. Then followed a long career at Brandeis University and many visits to foreign institutions. His work earned him many awards and led to exotic experiences detailed in the later chapters. The appendices contain semi-technical descriptions of some essential physics, as well as a more general commentary about the role of physics and physicists in understanding the universe.

Authors Philip R. Kesten and David L. Tauck take a fresh and innovative approach to the university physics (calculus-based) course. They combine their experience teaching physics (Kesten) and biology (Tauck) to create a text that engages students by using biological and medical applications and examples to illustrate key concepts. *University Physics for the Physical and Life Sciences* teaches the fundamentals of introductory physics, while weaving in formative physiology, biomedical, and life science topics to help students connect physics to living systems. The authors help life science and pre-med students develop a deeper appreciation for why physics is important to their future work and daily lives. With its thorough coverage of concepts and problem-solving strategies, *University Physics for the Physical and Life Sciences* can also be used as a novel approach to teaching physics to engineers and scientists or for a more rigorous approach to teaching the college physics (algebra-based) course. *University Physics for the Physical and Life Sciences* utilizes six key features to help students learn the principle concepts of university physics:

- A seamless blend of physics and physiology with interesting examples of physics in students' lives,
- A strong focus on developing problem-solving

skills (Set Up, Solve, and Reflect problem-solving strategy), • Conceptual questions (Got the Concept) built into the flow of the text, • "Estimate It!" problems that allow students to practice important estimation skills • Special attention to common misconceptions that often plague students, and • Detailed artwork designed to promote visual learning Volume I: 1-4292-0493-1 Volume II: 1-4292-8982-1

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 autopoietic 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.

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