Mechanical Design In Organisms

"Amongst animals, diversity of form and of environmental circumstances have given rise to a multitude of different adap tations subserving the relatively unified patterns of cellular metabolism. Nowhere else is this state of affairs better exem plified than in the realm of respiration". Jones (1972). The field of comparative respiratory biology is expanding almost exponentially. With the ever-improving analytical tools and methods of experimentation, its scope is blossoming to fascinating horizons. The innovativeness and productivity in the area continue to confound students as well as specialists. The increasing wealth of data makes it possible to broaden the information base and meaning fully synthesize, rationalize, reconcile, redefine, consolidate, and offer empirical validation of some of the earlier anecdotal views and interpretations, helping resolve the issues into adequately realistic and easily perceptible models. Occa sional reflections on the advances made, as well as on the yet unresolved prob lems, helps chart out new grounds, formulate new concepts, and stimulate inquiry. Moreover, timely assessments help minimize isolation among investiga tors, averting costly duplication of effort. This exposition focuses on the diversity of the design of the gas exchangers and gives a critical appraisal of the plausible or constrained the evolvement of respiration. The factors that have motivated cause-and-effect relationship between the phylogenetic, developmental, and en vironmental factors, conditions, and states which at various thresholds and under certain backgrounds conspired in molding the gas exchangers is argued.

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.

In this book, the author analyzes plant form and how it has evolved in response to basic physical laws. He examines the ways these laws limit the organic expression of form, size, and growth in a variety of plant structures and in plants as whole organisms, drawing on both the fossil record and studies of extant species.

Nature’s Machines: An Introduction to Organismal Biomechanics presents the fundamental principles of biomechanics in a concise, accessible way while maintaining necessary rigor. It covers the central principles of whole-organism biomechanics as they apply across the animal and plant kingdoms, featuring brief, tightly-focused coverage that does for biologists what H. M. Frost’s 1967 Introduction to Biomechanics did for physicians. Frequently encountered, basic concepts such as stress and strain, Young’s modulus, force coefficients, viscosity, and Reynolds number are introduced in early chapters in a self-contained format, making them quickly available for learning and as a refresher. More sophisticated, integrative concepts such as viscoelasticity or properties of hydrostats are covered in the later chapters, where they draw on information from multiple earlier sections of the book. Animal and plant biomechanics is now a common research area widely acknowledged by organismal biologists to have broad relevance. Most of the day-to-day activities of an animal involve mechanical processes, and to the extent that organisms are shaped by adaptive evolution, many of those adaptations are constrained and channelized by mechanical properties. The similarity in body shape of a porpoise and a tuna is no coincidence. Many may feel that they have an intuitive understanding of many of the mechanical processes that affect animals and plants, but careful biomechanical analyses often yield counterintuitive results: soft, squishy kelp may be better at withstanding pounding waves during storms than hard-shelled mollusks; really small swimmers might benefit from being spherical rather than streamlined; our bones can operate without breaking for decades, whereas steel surgical implants exhibit fatigue failures in a few months if not fully supported by bone. Offers organismal biologists and biologists in other areas a background in biomechanics to better understand the research literature and to explore the possibility of using biomechanics approaches in their own work Provides an introductory presentation of the everyday mechanical challenges faced by animals and plants Functions as recommended or required reading for advanced undergraduate biology majors taking courses in biomechanics, supplemental reading in a general organismal biology course, or background reading for a biomechanics seminar course

"Full of ideas and well-explained principles that will bring new understanding of everyday things to both scientists and non-scientists alike."—R. McNeill Alexander, Nature Nature and humans build their devices with the same earthly materials and use them in the same air and water, pulled by the same gravity. Why, then, do their designs diverge so sharply? Humans, for instance, love right angles, while nature's angles are rarely right and usually rounded. Our technology goes around on wheels—and on rotating pulleys, gears, shafts, and cams—yet in nature only the tiny propellers of bacteria spin as true wheels. Our hinges turn because hard parts slide around each other, whereas nature's hinges (a rabbit's ear, for example) more often swing by bending flexible materials. In this marvelously surprising, witty book, Steven Vogel compares these two mechanical worlds, introduces the reader to his field of biomechanics, and explains how the nexus of physical law, size, and convenience of construction determine the designs of both people and nature. "This elegant comparison of human and biological technology will forever change the way you look at each."—Michael LaBarbera, American Scientist
Biomechanics in Animal Behaviour offers a unique approach by integrating fully the fields of animal behaviour and biomechanics. It demonstrates how an understanding of biomechanical issues is an important part of evaluating and predicting animal behaviour. The book examines how behaviour is determined and/or constrained by biomechanical variables such as hydrodynamics, aerodynamics, kinematics, and the mechanical properties of biomaterials.

This second edition textbook offers an expanded conceptual synthesis of microbial ecology with plant and animal ecology. Drawing on examples from the biology of microorganisms and macroorganisms, this textbook provides a much-needed interdisciplinary approach to ecology. The focus is the individual organism and comparisons are made along six axes: genetic variation, nutritional mode, size, growth, life cycle, and influence of the environment. When it was published in 1991, the first edition of Comparative Ecology of Microorganisms and Macroorganisms was unique in its attempt to clearly compare fundamental ecology across the gamut of size. The explosion of molecular biology and the application of its techniques to microbiology and organismal biology have particularly demonstrated the need for interdisciplinary understanding. This updated and expanded edition remains unique. It treats the same topics at greater depth and includes an exhaustive compilation of both the most recent relevant literature in microbial ecology and plant/animal ecology, as well as the early research papers that shaped the concepts and theories discussed. Among the completely updated topics in the book are phylogenetic systematics, search algorithms and optimal foraging theory, comparative metabolism, the origins of life and evolution of multicellularity, and the evolution of life cycles. From Reviews of the First Edition: "John Andrews has succeeded admirably in building a bridge that is accessible to all ecologists." -Ecology "I recommend this book to all ecologists. It is a thoughtful attempt to integrate ideas from, and develop common themes for, two fields of ecology that should not have become fragmented." -American Scientist "Such a synthesis is long past due, and it is shameful that ecologists (both big and little) have been so parochial." -The Quarterly Review of Biology

This book examines the evolution of self-organised multicellular structures, and the remarkable transition from unicellular to multicellular life. It shows the way forward in developing new robotic entities that are versatile, cooperative and self-configuring.

This 1994 book was the first collection devoted to impact of natural sciences on content and form of economics in history.

The study of coelenterates is now one of the most active fields of invertebrate zoology. There are many reasons for this, and not everyone would agree on them, but certain facts stand out fairly clearly. One of them is that many of the people who study coelenterates do so simply because they are interested in the animals for their own sake. This, however, would be true for other invertebrate groups and cannot by itself explain the current boom in coelenterate work. The main reasons for all this activity seem to lie in the considerable concentration of research effort and funding into three broad, general areas of biology: marine ecology, cellular-developmental biology and neurobiology, in all of which coelenterates have a key role to play. They are the dominant organisms, or are involved in an important way, in a variety of marine habitats, of which coral reefs are only one, and this automatically ensures their claims on the attention of ecologists and marine scientists. Secondly, the convenience of hydra and some other hydroids as experimental animals has long made them a natural choice for a variety of studies on growth, nutrition, symbiosis, morphogenesis and sundry aspects of cell biology. Finally, the phylogenetic position of the coelenterates as the lowest metazoans having a nervous system makes them uniquely interesting to those neurobiologists and behaviorists who hope to gain insights into the functioning of higher nervous systems by working up from the lowest level.

The classic textbook on comparative biomechanics—revised and expanded Why do you switch from walking to running at a specific speed? Why do tall trees rarely blow over in high winds? And why does a spore ejected into air at seventy miles per hour travel only a fraction of an inch? Comparative Biomechanics is the first and only textbook that takes a comprehensive look at the mechanical aspects of life—covering animals and plants, structure and movement, and solids and fluids. An ideal entry point into the ways living creatures interact with their immediate physical world, this revised and updated edition examines how the forms and activities of animals and plants reflect the materials available to nature, considers rules for fluid flow and structural design, and explores how organisms contend with environmental forces. Drawing on physics and mechanical engineering, Steven Vogel looks at how animals swim and fly, modes of terrestrial locomotion, organism responses to winds and water currents, circulatory and suspension-feeding systems, and the relationship between size and mechanical design. He also investigates links between the properties of biological materials—such as spider silk, jellyfish jelly, and muscle—and their structural and functional roles. Early chapters and appendices introduce relevant physical variables for quantification, and problem sets are provided at the end of each chapter. Comparative Biomechanics is useful for physical scientists and engineers seeking a guide to state-of-the-art biomechanics. For a wider audience, the textbook establishes the basic biological context for applied areas—including ergonomics, orthopedics, mechanical prosthetics, kinesiology, sports medicine, and biomimetics—and provides materials for exhibit designers at science museums. Problem sets at the ends of chapters Appendices cover basic background information Updated and expanded documentation and materials Revised figures and text Increased coverage of friction, viscoelastic materials, surface tension, diverse modes of locomotion, and biomimetics

Solid Biomechanics is the first book to comprehensively review the mechanical design of organisms. With a physical approach and a minimum of mathematics, the textbook introduces readers to the world of structural mechanics and sheds light on the dazzling array of mechanical adaptations that link creatures as dissimilar as bacteria, plants, and animals. Exploring a wide range of subjects in depth, from spider silks and sharkskin to climbing plants and human food processing, this immensely accessible text demonstrates that the bodies of animals and plants are masterpieces of engineering, enabling them to survive in a hostile world. The textbook describes how organisms construct materials from limited components, arrange materials into efficient structures that withstand different types of stresses, and interact mechanically with their environment. Looking at practical and historical aspects of the subject, the book delves into how the mechanics of organisms might be applied to other engineering scenarios and considers the ways structural biomechanics could and should develop in the future if more is to be learned about the form and function of organisms. Solid Biomechanics will be useful to all those interested in how organisms work, from biologists and engineers to physicists and students of biomechanics, bionics, and materials science. The first comprehensive review of the structural mechanics of organisms Introduces the subject using a physical approach involving minimal mathematics Three complementary sections: materials, structures, and mechanical interactions of organisms Links the dazzling array of mechanical adaptations seen in widely differing organisms Practical and historical approach shows how

mechanical adaptations have been discovered and how readers can perform their own investigations
This book deals with an interface between mechanical engineering and biology. Available for the first time in paperback, it reviews biological structural materials and systems and their mechanically important features and demonstrates that function at any particular level of biological integration is permitted and controlled by structure at lower levels of integration. Five chapters discuss the properties of materials in general and those of biomaterials in particular. The authors examine the design of skeletal elements and discuss animal and plant systems in terms of mechanical design. In a concluding chapter they investigate organisms in their environments and the insights gained from study of the mechanical aspects of their lives.
Understanding materials, their properties and behavior is fundamental to engineering design, and a key application of materials science. Written for all students of engineering, materials science and design, this book describes the procedures for material selection in mechanical design in order to ensure that the most suitable materials for a given application are identified from the full range of materials and section shapes available. Extensively revised for this fourth edition, Materials Selection in Mechanical Design is recognized as one of the leading materials selection texts, and provides a unique and genuinely innovative resource. Features new to this edition * Material property charts now in full color throughout * Significant revisions of chapters on engineering materials, processes and process selection, and selection of material and shape while retaining the book's hallmark structure and subject content * Fully revised chapters on hybrid materials and materials and the environment * Appendix on data and information for engineering materials fully updated * Revised and expanded end-of-chapter exercises and additional worked examples Materials are introduced through their properties; materials selection charts (also available on line) capture the important features of all materials, allowing rapid retrieval of information and application of selection techniques. Merit indices, combined with charts, allow optimization of the materials selection process. Sources of material property data are reviewed and approaches to their use are given. Material processing and its influence on the design are discussed. New chapters on environmental issues, industrial engineering and materials design are included, as are new worked examples, exercise materials and a separate, online Instructor's Manual. New case studies have been developed to further illustrate procedures and to add to the practical implementation of the text. * The new edition of the leading materials selection text, now with full color material property charts * Includes significant revisions of chapters on engineering materials, processes and process selection, and selection of material and shape while retaining the book's hallmark structure and subject content * Fully revised chapters on hybrid materials and materials and the environment * Appendix on data and information for engineering materials fully updated * Revised and expanded end-of-chapter exercises and additional worked examples
Many potential applications of synthetic and systems biology are relevant to the challenges associated with the detection, surveillance, and responses to emerging and re-emerging infectious diseases. On March 14 and 15, 2011, the Institute of Medicine's (IOM's) Forum on Microbial Threats convened a public workshop in Washington, DC, to explore the current state of the science of synthetic biology, including its dependency on systems biology; discussed the different approaches that scientists are taking to engineer, or reengineer, biological systems; and discussed how the tools and approaches of synthetic and systems biology were being applied to mitigate the risks associated with emerging infectious diseases. The Science and Applications of Synthetic and Systems Biology is organized into sections as a topic-by-topic distillation of the presentations and discussions that took place at the workshop. Its purpose is to present information from relevant experience, to delineate a range of pivotal issues and their respective challenges, and to offer differing perspectives on the topic as discussed and described by the workshop participants. This report also includes a collection of individually authored papers and commentary.
This volume explores questions about conceptual change from both scientific and philosophical viewpoints by analyzing the recent history of evolutionary developmental biology. It features revised papers that originated from the workshop "Conceptual Change in Biological Science: Evolutionary Developmental Biology, 1981-2011" held at the Max Planck Institute for the History of Science in Berlin in July 2010. The Preface has been written by Ron Amundson. In these papers, philosophers and biologists compare and contrast key concepts in evolutionary developmental biology and their development since the original, seminal Dahlem conference on evolution and development held in Berlin in 1981. Many of the original scientific participants from the 1981 conference are also contributors to this new volume and, in conjunction with other expert biologists and philosophers specializing on these topics, provide an authoritative, comprehensive view on the subject. Taken together, the papers supply novel perspectives on how and why the conceptual landscape has shifted and stabilized in particular ways, yielding insights into the dynamic epistemic changes that have occurred over the past three decades. This volume will appeal to philosophers of biology studying conceptual change, evolutionary developmental biologists focused on comprehending the genesis of their field and evaluating its future directions, and historians of biology examining this period when the intersection of ev olution and development rose again to prominence in biological science.
"This book should go a long way towards filling the communication gap between biology and physics in the area of biomaterials]. It begins with the basic theory of elasticity and viscoelasticity, describing concepts like stress, strain, compliance, and plasticity in simple mathematical terms. . . . For the non-biologist, these chapters provide a clear account of macromolecular structure and conformation. . . . Vincent's work] is a delight to read, full of interesting anecdotes and examples from unexpected sources. . . . I can strongly recommend this book, as it shows how biologists could use mechanical properties as well as conventional methods to deduce molecular structure."--Anna Furth, The Times Higher Education Supplement In what is now recognized as a standard introduction to biomaterials, Julian Vincent presents a biologist's analysis of the structural materials of

organisms, using molecular biology as a starting point. He explores the chemical structure of both proteins and polysaccharides, illustrating how their composition and bonding determine the mechanical properties of the materials in which they occurincluding pliant composites such as skin, artery, and plant tissue; stiff composites such as insect cuticle and wood; and biological ceramics such as teeth, bone, and eggshell. Here Vincent discusses the possibilities of taking ideas from nature with biomimicry and "intelligent" (or self-designing and sensitive) materials.

Michael Foote and Arnold Miller have stepped in to revise this classic text. It is their vision to take the core approach of the second edition, and reflect the substantial changes to the rudiments of the subject from the previous two decades. This third edition remains an excellent text for those studying geophysical sciences.

Dr. Lester A. Gerhardt Professor and Chairman Electrical, Computer, and Systems Engineering Rensselaer Polytechnic Institute Troy, New York 12180 This book is a collection of papers on the subject of Robotics and Artificial Intelligence. Most of the papers contained herein were presented as part of the program of the NATO Advanced Study Institute held in June 1983 at Castel vecchio Pascoli, Italy on the same subject. Attendance at this two week Institute was by invitation only, drawing people internationally representing industry, government and the academic community worldwide. Many of the people in attendance, as well as those presenting papers, are recognized leaders in the field. In addition to the formal paper presentations, there were several informal work shops. These included a workshop on sensing, a workshop on educational methodology in the subject area, as examples. This book is an outgrowth and direct result of that Institute and includes the papers presented as well as a few others which were stimulated by that meeting. A special note is the paper entitled "State-of-the-Art and Predictions for Artificial Intelligence and Robotics" by Dr. R. Nagel which appears in the Introduction and Overview chapter of this book. This paper was originally developed as part of a study for the United States Army performed by the National Research Council of the National Academy of Science and published as part of a report entitled "Applications of Robotics and Artificial Intelligence to Reduce Risk and Improve Effectiveness" by National Academy Press in 1983.

This is a thoroughly revised, updated, and expanded edition of a classic illustrated introduction to the structural materials in natural organisms and what we can learn from them to improve man-made technology--from nanotechnology to textiles to architecture. Julian Vincent's book has long been recognized as a standard work on the engineering design of biomaterials and is used by undergraduates, graduates, researchers, and professionals studying biology, zoology, engineering, and biologically inspired design. This third edition incorporates new developments in the field, the most important of which have been at the molecular level. All of the illustrations have been redrawn, the references have been updated, and a new chapter on biomimetic design has been added. Vincent emphasizes the mechanical properties of structural biomaterials, their contribution to the lives of organisms, and how these materials differ from man-made ones. He shows how the properties of biomaterials are derived from their chemistry and interactions, and how to measure them. Starting with proteins and polysaccharides, he shows how skin and hair function, how materials self-assemble, and how ceramics such as bone and mother-of-pearl can be so stiff and tough, despite being made in water in benign ambient conditions. Finally, he combines these topics with an analysis of how the design of biomaterials can be adapted in technology, and presents a series of guidelines for designers. An accessible illustrated introduction with minimal technical jargon Suitable for undergraduates and more advanced readers Integrates chemistry, mechanics, and biology Includes descriptions of all biological materials Simple exposition of mechanical analysis of materials

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Hierarchical structures are those assemblages of molecular units or their aggregates embedded within other particles or aggregates that may, in turn, be part of even larger units of increasing levels of organization. This volume reviews the state of the art of synthetic techniques and processing procedures for assembling these structures. Typical natural-occurring systems used as models for synthetic efforts and insight on properties, unusual characteristics, and potential end-use applications are identified. Suggestions are made for research and development efforts to mimic such structures for broader applications.

International interest in nanoscience research has flourished in recent years, as it becomes an integral part in the development of future technologies. The diverse, interdisciplinary nature of nanoscience means effective communication between disciplines is pivotal in the successful utilization of the science. Nanochemistry: A Chemical Approach to Nanomaterials is the first textbook for teaching nanochemistry and adopts an interdisciplinary and comprehensive approach to the subject. It presents a basic chemical strategy for making nanomaterials and describes some of the principles of materials self-assembly over 'all' scales. It demonstrates how nanometre and micrometre scale building blocks (with a wide range of shapes, compositions and surface functionalities) can be coerced through chemistry to organize spontaneously into unprecedented structures, which can serve as tailored functional materials. Suggestions of new ways to tackle research problems and speculations on how to think about assembling the future of nanotechnology are given. Primarily designed for teaching, this book will appeal to graduate and advanced undergraduate students. It is well illustrated with graphical representations of the structure and form of nanomaterials and contains problem sets as well as other pedagogical features such as further reading, case studies and a comprehensive bibliography.

This book provides a clear foundation, based on physical biology and biomechanics, for understanding the underlying mechanisms by which animals have evolved to move in their physical environment. It integrates the biomechanics of animal movement with the physiology of animal energetics and the neural control of locomotion. The author also communicates a sense of the awe and fascination that comes from watching the grace, speed, and power of animals in motion. Movement is a fundamental distinguishing feature of animal life, and a variety of extremely effective mechanical and physiological designs have evolved. Common themes are observed for the ways in which animals successfully contend with the properties of a given physical environment across diversity of life forms and varying locomotor modes. Understanding the common principles of design that span a diverse array of animals requires a broad comparative and integrative approach to their study. This theme persists throughout the book, as various modes and mechanisms of animal locomotion are covered. Since an animal's size is equally critical to its functional design, the effects of scale on locomotor energetics and mechanics are also discussed. Biewener begins by examining the underlying machinery for movement: skeletal muscles used for force generation, skeletons used for force transmission, and spring-like elements used for energy savings. He then describes the basic mechanisms that animals have evolved to move over land, in and on the surface of the water, and in the air. Common fluid dynamic principles are discussed as background to both swimming and flight. In addition to discussing the locomotor mechanisms of complex animals, the locomotor movement of single cells is also covered. Common biochemical features of cellular metabolism are then reviewed before discussing the energetic aspects of various locomotor modes. Strategies for conserving energy and moving economically are again highlighted in this section of the book. Emphasis is placed on comparisons of energetic features across locomotor modes. The book concludes with a discussion of the neural control of animal locomotion. The basic neurosensory and motor elements common to vertebrates and arthropods are discussed, and features of sensori-motor organization and function are highlighted. These are then examined in the context of specific examples of how animals control the rhythmic patterns of limb and body movement that underlie locomotor function and stability.

In order to achieve the revolutionary new defense capabilities offered by materials science and engineering, innovative management to reduce the risks associated with translating research results will be needed along with the R&D. While payoff is expected to be high from the promising areas of materials research, many of the benefits are likely to be evolutionary. Nevertheless, failure to invest in more speculative areas of research could lead to undesired technological surprises. Basic research in physics, chemistry, biology, and materials science will provide the seeds for potentially revolutionary technologies later in the 21st century.

'With admirable clarity, Mrs Peters sums up what determines competence in spelling and the traditional and new approaches to its teaching.' -Times Literary Supplement

The purpose of this book is to present the state of knowledge concerning nutrition and point out directions for future work for the Echinodermata, an ancient group which shows great diversity in form and function, and whose feeding activities can have great environmental impact.

This entertaining and informative book describes how living things bump up against non-biological reality. "My immodest aim," says the author, "is to change how you view your immediate surroundings." He asks us to wonder about the design of plants and animals around us: why a fish swims more rapidly than a duck can paddle, why healthy trees more commonly uproot than break, how a shark manages with such a flimsy skeleton, or how a mouse can easily survive a fall onto any surface from any height. The book will not only fascinate the general reader but will also serve as an introductory survey of biomechanics. On one hand, organisms cannot alter the earth's gravity, the properties of water, the compressibility of air, or the behavior of diffusing molecules. On the other, such physical factors form both constraints with which the evolutionary process must contend and opportunities upon which it might capitalize. Life's Devices includes examples from every major group of animals and plants, with references to recent work, with illustrative problems, and with suggestions of experiments that need only common household materials.

This book describes how the principle of self-sufficiency can be applied to a reconfigurable modular robotic organism. It shows the design considerations for a novel REPLICATOR robotic platform, both hardware and software, featuring the behavioral characteristics of social insect colonies. Following a comprehensive overview of some of the bio-inspired techniques already available, and of the state-of-the-art in re-configurable modular robotic systems, the book presents a novel power management system with fault-tolerant energy sharing, as well as its implementation in the REPLICATOR robotic modules. In addition, the book discusses, for the first time, the concept of “artificial energy homeostasis” in the context of a modular robotic organism, and shows its verification on a custom-designed simulation framework in different dynamic power distribution and fault tolerance scenarios. This book offers an ideal reference guide for both hardware engineers and software developers involved in the design and implementation of autonomous robotic systems.

Mechanical Design of Structural Materials in Animals explores the principles underlying how molecules interact to produce the functional attributes of biological materials: their strength and stiffness, ability to absorb and store energy, and ability to resist the fatigue that accrues through a lifetime of physical insults. These attributes play a central role in determining the size and shape of animals, the ways in which they can move, and how they interact with their environment. By showing how structural materials have been designed by evolution, John Gosline sheds important light on how animals work. Gosline elucidates the pertinent theories for how molecules are arranged into macromolecular structures and how those structures are then built up into whole organisms. In particular, Gosline develops the theory of discontinuous, fiber-reinforced composites, which he employs in a grand synthesis to explain the properties of everything from the body wall of sea anemones to spiders' silks and insect cuticles, tendons, ligaments, and bones. Although the theories are examined in depth, Gosline's elegant discussion makes them accessible to anyone with an interest in the mechanics of life. Focusing on the materials from which animals are constructed, this book answers fundamental questions about mechanical properties in nature.

Addressing general readers and biologists, Mark Denny shows how the physics of fluids (in this case, air and water) influences the often fantastic ways in which life forms adapt themselves to their terrestrial or aquatic "media."

Introductory Biomechanics is a new, integrated text written specifically for engineering students. It provides a broad overview of this important branch of the rapidly growing field of bioengineering. A wide selection of topics is presented, ranging from the mechanics of single cells to the dynamics of human movement. No prior biological knowledge is assumed and in each chapter, the relevant anatomy and physiology are first described. The biological system is then analyzed from a mechanical viewpoint by reducing it to its essential elements, using the laws of mechanics and then tying mechanical insights back to biological function. This integrated approach provides students with a deeper understanding of both the mechanics and the biology than from qualitative study alone. The text is supported by a wealth of illustrations, tables and examples, a large selection of suitable problems and hundreds of current references, making it an essential textbook for any biomechanics course.

Plants and animals interact with each other and their surroundings, and these interactions—with all their complexity and contingency—control where species can survive and reproduce. In this comprehensive and groundbreaking introduction to the emerging field of ecological mechanics, Mark Denny explains how the principles of physics and engineering can be used to understand the intricacies of these remarkable relationships. Denny opens with a brief review of basic physics before introducing the fundamentals of diffusion, fluid mechanics, solid mechanics, and heat transfer, taking care to explain each in the context of living organisms. Why are corals of different shapes on different parts of a reef? How can geckos climb sheer walls? Why can birds and fish migrate farther than mammals? How do desert plants stay cool? The answers to these and a host of similar questions illustrate the principles of heat, mass, and momentum transport and set the stage for the book's central topic—the application of these principles in ecology. Denny shows how variations in the environment—in both space and time—affect the performance of plants and animals. He introduces spectral analysis, a mathematical tool for quantifying the patterns in which environments vary, and uses it to analyze such subjects as the spread of invasive species. Synthesizing the book’s materials, the final chapters use ecological mechanics to predict the occurrence and consequences of extreme ecological events, explain the emergence of patterns in the distribution and abundance of organisms, and empower readers to explore further. Ecological Mechanics offers new insights into the physical workings of organisms and their environment.

Physical (Biological) Anthropology theme is a component of Encyclopedia Of Biological, Physiological And Health Sciences (EOLSS), which is an integrated compendium of twenty one Encyclopedias. Biological anthropology, also known as physical anthropology, is a scientific discipline concerned with the biological and behavioral aspects of human beings, their related non-human primates and their extinct hominin ancestors. It is a subfield of anthropology that provides a biological perspective to the systematic study of human beings. This volume is aimed at the following five major target audiences: University and College Students Educators, Professional Practitioners, Research Personnel and Policy Analysts, Managers, and Decision Makers, NGOs and GOs.

This is a comprehensive and accessible overview of what is known about the structure and mechanics of bone, bones, and teeth. In it, John Currey incorporates critical new concepts and findings from the two decades of research since the publication of his highly regarded The Mechanical Adaptations of Bones. Crucially, Currey shows how bone structure and bone's mechanical properties are intimately bound up with each other and how the mechanical properties of the material interact with the structure of whole bones to produce an adapted structure. For bone tissue, the book discusses stiffness, strength, viscoelasticity, fatigue, and fracture mechanics properties. For whole bones, subjects dealt with include buckling, the optimum hollowness of long bones, impact fracture, and properties of cancellous bone. The effects of mineralization on stiffness and toughness and the role of microcracking in the fracture process receive particular attention. As a zoologist, Currey views bone and bones as solutions to the design problems that vertebrates have faced during their evolution and throughout the book considers what bones have been adapted to do. He covers the full range of bones and bony tissues, as well as dentin and enamel, and uses both human and non-human examples. Copiously illustrated, engagingly written, and assuming little in the way of prior knowledge or mathematical background, Bones is both an ideal introduction to the field and also a reference sure to be frequently consulted by practicing researchers.

The view of nature and technology inhabiting totally different, even opposite, spheres persists across time and cultures. Most people would consider an English countryside or a Louisiana bayou to be "natural," though each is to an extent the product of technology. Pollution, widely thought to be a purely man-made phenomenon, results partly from natural processes. All around us, things from the natural world are brought into the human world. At what point do we consider them part of culture rather than nature? And does such a distinction illuminate our world or obscure its workings? This compelling new book challenges the view that a clear and unwavering boundary exists between nature and technology. Rejecting this dichotomy, the contributors show how the history of each can be united in a constantly shifting panorama where definitions of "nature" and "technology" alter and overlap. In addition to recognizing the artificial divide between these two concepts, the essays in this book demonstrate how such thinking may affect societies’ ability to survive and prosper. The answers and ideas are as numerous as the landscapes they consider, for there is no single path toward a more harmonious vision of technology and nature. Technologies that work in one place may not in another. Nature that is preserved in one community might become the raw material of technological progress somewhere else. Add to this the fact that the natural world and technology are not passive players, but are profoundly involved in cultural construction. Understanding such dynamics not only reveals a new historical complexity; it prepares us for coping with many of the most difficult and pressing social issues facing us today. Contributors Peter Coates * Craig E. Colten * Stephen H. Cutcliffe * Hugh S. Gorman * Betsy Mendelsohn * Joy Parr * Peter C. Perdue * Sara B. Pritchard * Martin Reuss * William D. Rowley * Edmund Russell * Joel A. Tarr * Ann Vileisis * James C. Williams * Thomas Zeller