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Biology and Information
Application of Thermodynamics to Biological and Materials Science
Thermodynamics and Biophysics of Biomedical Nanosystems

CABRERA HALLIE

Biological Thermodynamics John Wiley &

Sons
The main goal of this book is to describe in physical terms the peculiar features of "machines" having molecular dimensions that play the principal role in the most important biological processes, viz., energy transduction and enzyme catalysis. Since these molecular engines work with thermal, chemical, and mechanical energy, the appropriate framework to discuss them comes from thermodynamics and chemical kinetics. The book thus begins with a review of the thermodynamics and chemical kinetics. It then discusses the notion of molecular machines, and in particular, the problems associated with applying thermodynamics to small systems such as enzymes. The authors then turn to enzyme catalysis, discussing theoretical and experimental investigations of protein dynamics. The concluding chapter deals with energy transduction in biological membranes, focusing on ATP synthesis.

Biological Thermodynamics Springer
Thermodynamics in Bioenergetics aims to supply students with the knowledge and understanding of the critical concepts and theories that are needed in the biochemistry and bioenergetics fields. Biochemical reactions highlighting thermodynamics, chemical kinetics, and enzymes are addressed in the text. Author, Jean-Louis Burgot, guides the reader through the starting points, strategy description, and theory results to facilitate their comprehension of the theories and examples being discussed in the book. Also discussed in the text are the notions of Gibbs energy, entropy, and exergonic and endergonic reactions.

Origin Of Natural Order, The: An Axiomatic Theory Of Biology CRC Press
This book highlights the recent advances of thermodynamics and biophysics in drug delivery nanosystems and in biomedical nanodevices. The up-to-date book provides an in-depth knowledge of bio-inspired nanotechnological systems for pharmaceutical applications. Biophysics and thermodynamics, supported by mathematics, are the locomotive by which the drug transportation and the targeting processes will be achieved under the light of the modern pharmacotherapy. They are considered as scientific tools that promote the understanding of physicochemical and thermotropic functionality and behavior of artificial cell membranes and structures like nanoparticulate systems. Therefore, this book focusses on new aspects of biophysics and thermodynamics as important elements for evaluating biomedical nanosystems, and it correlates their physicochemical, biophysical and thermodynamical behaviour with those of a living organism. In 2018, Prof. Demetzos was honored with an award by the Order of Sciences of the Academy of Athens for his scientific contribution in Pharmaceutical Nanotechnology.

Nonequilibrium Thermodynamics Springer
Entropy for Biologists: An Introduction to Thermodynamics is an introductory book for people in the life sciences who wish to master the concepts of thermal physics without being forced to a degree and rate of symbol manipulation which is foreign to their patterns of thought. The book opens with a chapter on temperature, followed by separate chapters that discuss the concepts of energy, kinetic theory, total energy, the second law of thermodynamics, entropy, and probability and information theory. Subsequent chapters deal with statistical mechanics and its relation to

thermodynamics, free-energy functions, applications of the Gibbs free energy and the Gibbs chemical potential, and measurement in thermal physics. The book is primarily directed at those graduate and advanced undergraduate students of biology and biochemistry who wish to develop a sense of confidence about their understanding of the thermal physics which will be useful in pursuing their work. It may also prove useful to professionals who wish to bolster their knowledge in this area.
Thermodynamics in Biology Elsevier
Natural phenomena consist of simultaneously occurring transport processes and chemical reactions. These processes may interact with each other and lead to instabilities, fluctuations, and evolutionary systems. This book explores the unifying role of thermodynamics in natural phenomena. Nonequilibrium Thermodynamics, Second Edition analyzes the transport processes of energy, mass, and momentum transfer processes, as well as chemical reactions. It considers various processes occurring simultaneously, and provides students with more realistic analysis and modeling by accounting possible interactions between them. This second edition updates and expands on the first edition by focusing on the balance equations of mass, momentum, energy, and entropy together with the Gibbs equation for coupled processes of physical, chemical, and biological systems. Every chapter contains examples and practical problems to be solved. This book will be effective in senior and graduate education in chemical, mechanical, systems, biomedical, tissue, biological, and biological systems engineering, as well as physical, biophysical, biological, chemical, and biochemical sciences. Will help readers in understanding and modelling some of the coupled and complex systems, such as coupled transport and chemical reaction cycles in biological systems Presents a unified approach for interacting processes - combines analysis of transport and rate processes Introduces the theory of nonequilibrium thermodynamics and its use in simultaneously occurring transport processes and chemical reactions of physical, chemical, and biological systems A useful text for students taking advanced thermodynamics courses
Biology and Information IntechOpen
This book is devoted to the question: What fundamental ideas and concepts can phys ics contribute to the analysis of complex systems like those in biology and ecolo gy? The book originated from two lectures which I gave during the winter term 1974/75 and the summer term 1976 at the Rheinisch-Westfalische Technische Hoch schule in Aachen. The wish for a lecture with this kind of subject was brought forward by students of physics as well as by those from other disciplines like biology, physiology, and engineering sciences. The students of physics were look ing for ways which might lead them from their monodisciplinary studies into the interdisciplinary field between physics and life sciences. The students from the other disciplines suspected that there might be helpful physical concepts and ideas for the analysis of complex systems they ought to become acquainted with. It is clear that a lecture or a book which tries to realize the expectations of both these groups will meet with difficulties arising from the different train ings and background knowledge of physicists and nonphysicists. For the physicists, I have

tried to give a brief description of the biological aspect and significance of a problem wherever it seems necessary and appropriate and as far as a physicist like me feels authorized to do so.

Nonequilibrium Thermodynamics CRC Press

Highlighted with individual contributions from eminent specialists, these multiauthored volumes combine authority, inspiration and state-of-the-art knowledge. Both informative and inspiring they are designed to appeal to scientists and interested laypeople alike. Volume 2 complements and extends the scope of the first, with the biological viewpoint being stressed. Following an introductory chapter on design as understood in biology, the various aspects of the biological information revolution are addressed. Areas discussed include molecular structure, the genome, development, and neural networks. A section on information theory provides a link with engineering, and the scope is also broadened to include the implications of motion in nature and engineering.

Thermal Biophysics of Membranes World Scientific

Biophysical Chemistry, Volume I: Thermodynamics, Electrostatics, and the Biological Significance of the Properties of Matter focuses on the biological aspects of the properties of matter, putting emphasis on the chemical elements, water and carbon dioxide, complex molecules, and proteins. The publication first elaborates on biochemistry and geochemistry, water and its biological significance, and the problems of protein structure. Discussions focus on the number of peptide chains in the molecule and nature of terminal groups, latent heat of fusion, characteristics of the amino acids derived from proteins, expansion of water in freezing, and the relative abundance of chemical elements in the universe. The text then takes a look at thermodynamics and the application to polar molecules and ionic solutions of electrostatics, including free energy of a charged sphere, image charges, salting-out effect, expressions for the change of fundamental thermodynamic functions, and chemical potentials. The book examines the conductivity of electrolytes, acid-base equilibria, and polybasic acids, bases, and ampholytes, including proteins. Topics include ionization of cysteine, isoelectric points of polyvalent ampholytes, hemoglobin, nature of acids and bases, measurement of conductivity, electrolytes as conductors, and the moving boundary method of determining transference numbers. The manuscript is a dependable reference for chemists and researchers interested in thermodynamics, electrostatics, and the biological value of the properties of matter.

Thermodynamics and Kinetics for the Biological Sciences Walter de Gruyter

Foundations of Bioenergetics provides an introduction to the physical foundations of bioenergetics and the methods of applying these constructs to biological problems. It combines parts of thermal physics, biochemistry, ecology, and cellular and organismic biology into a single coherent work. Much of the material in this volume comes from ""Entropy for Biologists,"" an introductory thermodynamics book aimed particularly at life scientists. Some of the topics originally appeared in the monograph ""Energy Flow in Biology."" The current volume expands on that material with respect to biological applications and attempts to

bridge the gap between physics and biology. The book explains basic concepts such as energy, temperature, the second law of thermodynamics, entropy, information theory, and statistical mechanics. It discusses the relations between thermodynamics and statistical mechanics, free-energy functions, radiant energy, the free energy of cells and tissue, chemical kinetics, and cyclic flows. It examines the relationships between energy flows and biological processes; applications of the concepts of Gibbs free energy, chemical potential, and activity; and measurements of temperature, energy, and thermochemical quantities. The book also includes chapters that deal with irreversible dynamics, irreversible theory, and osmotic flow.
Cambridge University Press
All sorts of biological activities are processed thermodynamically, and at the utmost fundamental level, the laws of biology must be thermodynamics. However, the current laws of thermodynamics are unable to give reasonable explanation of biological processes. In order to do so, irreversible thermodynamics has been theorized to describe the basic mechanism for the origin of natural order or the development of things (related to developmental biology). The scientific definition of the system theory concept has been obtained and the properties of a biological system can be analyzed by applying principles of it. Irreversible thermodynamics and system theory act as the theoretical foundation for theoretical biology. By applying principles of irreversible thermodynamics and system theory, the axiomatic theory of biology has been developed. Contents: PrefaceIntroductionPhysical Foundation: The Essence of Irreversible ThermodynamicsThe Origin of Natural OrderThe Developing System and Hierarchical Structure of ThingsPartition Function of a Thermodynamic SystemDissipative Structure and Thermodynamic Structure TheorySystem Logic and System Theory: The Scientific Definition of the SystemLogic Discontinuity and Continuity Between Different Levels of Hierarchical StructureSystem LogicIsolating Logic Relationship Between Complex SystemsAxiomatic Theory of Biology: Irreversible Thermodynamic Structure Theory for Protein FoldingCan We Go from Protein Sequence to Protein Structure?Protein Thermodynamic Structure TheoryGeneral Properties of a ProteinProtein ConformationDynamic and Thermodynamic Nature of Protein Conformational ChangeProtein Ligand InteractionThe Receptor Activation and Fashions of Protein RegulationThe Basic Thermodynamic Principles of Enzyme Catalyzed ReactionProtein Conformational Change and Enzyme ActivityAllodynamic Regulation Model for Enzyme Regulation — A Thermodynamic ViewThe Protein EvolutionA Thermodynamic Model for Bio-signalsProtein Flexibility as a BiosignalSignal Conduction and Neural ConductionSignaling Network Theory and System BiologyBiological DevelopmentHybridization and Hybrid VigorBiological EvolutionScientific Explanation of Traditional Chinese Medical Theory Readership: Graduate students, educators, university lecturers in biophysics. Keywords: Ligands;Protein Folding;DNA;Entropy;Thermodynamics;System Biology;Developmental SystemsReview: Key Features: The first axiomatic theory of biologyIt has unified fields of mathematics, thermodynamics,

biologyIt agrees with experimental results in diversified fields of biology well
Biophysical Thermodynamics of Intracellular Processes Springer Science & Business Media
Progress of thermodynamics has been stimulated by the findings of a variety of fields of science and technology. The principles of thermodynamics are so general that the application is widespread to such fields as solid state physics, chemistry, biology, astronomical science, materials science, and chemical engineering. The contents of this book should be of help to many scientists and engineers.
Thermodynamics and Regulation of Biological Processes Wiley-Interscience
Nonequilibrium Thermodynamics: Transport and Rate Processes in Physical, Chemical and Biological Systems, Fourth Edition emphasizes the unifying role of thermodynamics in analyzing natural phenomena. This updated edition expands on the third edition by focusing on the general balance equations for coupled processes of physical, chemical and biological systems. Updates include stochastic approaches, self-organization criticality, ecosystems, mesoscopic thermodynamics, constructual law, quantum thermodynamics, fluctuation theory, information theory, and modeling the coupled biochemical systems. The book also emphasizes nonequilibrium thermodynamics tools, such as fluctuation theories, mesoscopic thermodynamic analysis, information theories, and quantum thermodynamics in describing and designing small scale systems. Provides a useful text for seniors and graduate students from diverse engineering and science programs Highlights the fundamentals of equilibrium thermodynamics, transport processes and chemical reactions Expands the theory of nonequilibrium thermodynamics and its use in coupled transport processes and chemical reactions in physical, chemical and biological systems Presents a unified analysis for transport and rate processes in various time and space scales Discusses stochastic approaches in thermodynamic analysis, including fluctuation and information theories, mesoscopic nonequilibrium thermodynamics, constructal law and quantum thermodynamics
Biophysical Chemistry CRC Press
Gain a working knowledge of thermodynamics and kinetics with a minimum of mathematics-a guide for individuals in the biological sciences An understanding of thermodynamics and kinetics is essential for researchers investigating molecular phenomena in diverse disciplines, including bioorganic chemistry, medicinal chemistry, biochemistry, pharmaceuticals, and biology. The use of these physical chemistry tools in the biological sciences has exploded over the past fifteen years, but the majority of works on thermodynamics and kinetics require mathematical expertise beyond that of many researchers in the field. Presenting a highly accessible introduction to thermodynamics and kinetics, Thermodynamics and Kinetics for the Biological Sciences employs a minimum of mathematics, assuming only a basic calculus background, while treating a wide range of topics in a logical and easy-to-follow style. All principles and concepts are clearly illustrated through the use of relevant applications and examples from the biological sciences, and explanations are further enhanced with problems and up-to-date

references. Written by a world-renowned authority on biochemical kinetics, this remarkable book also features an easy-to-understand statistical development of entropy and a more extensive coverage of chemical kinetics and ligand binding to macromolecules than is usually found in books of this kind. Readers will acquire a working knowledge of thermodynamics and kinetics that they can readily apply to biological systems and use for exploring the scientific literature.

Nonequilibrium Thermodynamics CRC Press

Proceedings of the NATO Advanced Study Institute, Tabiano, Parma, Italy, May 21-June 1, 1979

Entropy Principle for the Development of Complex Biotic Systems Springer Science & Business Media

The concept of entropy in thermodynamics is a complex one, though it is fundamental in understanding physics, the workings of the mind, and biology. Entropy is the measure of the quality of energy, and it can also refer to the turn from order to disorder or randomness in isolated systems. In open systems, such as biology, entropy is formulated in terms of production and energy flow. This book establishes a novel view of complex biological systems and the earth using this concept of entropy, encompassing the interdisciplinary area of biology, ecology and physics. This book considers the development over time of a range of biologically complex systems such as plants, animals, humans, and ecosystems, describing them in terms of the second law of thermodynamics, entropy. With its broad coverage of biological systems, this book will be useful for students of environmental science as well as students in biology and physics. Includes discussion of multiple complex systems including the earth and biological systems within it. Suitable for those with little physics background who wish to learn how the laws of physics apply to ecological systems. Clearly organized by system, making information easy to access.

Biological Thermodynamics OUP Oxford

Over the past several decades there has been increasing research interest in thermodynamics as applied to biological systems. This concerns topics such as muscle work and internal energy such as fat and starch. Applications of the first and second laws of thermodynamics to the human body are important to dieticians and health science experts, and applications of these concepts to the animal body are a major concern of animal scientists. This book covers these key topics, which are typically not covered in classic or traditional thermodynamics texts used in mechanical and chemical engineering.

Thermodynamics and Regulation of Biological Processes Springer Science & Business Media

The Nature of Biological Systems as Revealed by Thermal Methods is a guide for experiments using thermal methods. The Editor has used his many years of experience to create a unique resource that will enable others with a less mathematical background, to realize the beauty and power of this tool and to gain a better understanding of biological problems. Biological calorimetry (and of course thermal analysis) is of increasing interest and is not covered thoroughly in other resources. The methods presented are macroscopic, for the rather inhomogeneous material (micromethods are often not possible or not pertinent). This book will help beginners in the field of thermal analysis or calorimetry

understand the principles of thermodynamics being applied to biological systems. Biological systems are highly organized and very complex. The water and the different types of weak interactions among the macromolecules make the interpretation of thermal events very difficult. This book includes examples how to handle such problems. The Nature of Biological Systems as Revealed by Thermal Methods is unique in that it: -has a broad spectrum, from molecules and biochemistry, tissues, and food, to whole organisms; -combines practical problems (food processing, quality control, thermal denaturation of proteins, plants and small insects, etc.) with concrete solutions and interpretation; -provides practical strategies and tools without "dry physics and mathematics"; -initiates the application of thermal methods in new fields (e.g. medicine); -forces the reader to go into more detail of thermodynamics and thermal techniques; -simplifies communication between biologists, medical doctors and experts of thermal analysis. The book is an invaluable resource for anyone interested in thermodynamics, including practising professionals applying thermal methods to biological problems; researchers and graduate students beginning work using thermal methods; and specialists of thermal analysis starting work on biological problems. In addition, this book will be a useful resource for libraries and institutes as the only book covering quantitative thermal analysis of biological systems.

Thermodynamics and Kinetics of Biological Processes Garland Science

Discusses the history and biological processes of thermodynamics. The first half of the book covers theoretical aspects of thermodynamic principles which will aid in understanding biochemical processes. Later chapters deal with the interpretation of data obtained from biochemical reactions, ligand binding, and calorimetric measurements on biological systems.

Thermodynamics in Bioenergetics Springer

The book begins with a brief review of equilibrium systems and transport and rate processes, then covers the following areas: theory of nonequilibrium thermodynamics; dissipation function; entropy and exergy; analysis and case studies on using the second law of thermodynamics; economic impact of the nonequilibrium thermodynamics theory; analysis of transport and rate processes; membrane transport; dissipative structures and biological systems; and other thermodynamic approaches and extended nonequilibrium thermodynamics. · Summarizes new applications of thermodynamics as tools for design and optimisation · Covers second law and exergy analysis for sustainable development · Promotes understanding of the coupled phenomena of natural processes

Mechanics and Thermodynamics of Biomembranes Oxford University Press, USA

An accessible introduction to thermodynamics for undergraduate biology and biochemistry students.

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