
Biomimetics For Architecture Learning From Nature

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CAMERON OROZCO

Biomimetic Research
for Architecture and
Building Construction

CRC Press

From leaves to liquids, caves to crystal formations, nature has always been a major source of inspiration for architects. This book examines how nature can act as a precedent for design solutions through twelve case studies. Packed with computer drawings, sketches, models, and photographs, this will be an ideal resource of ideas for students in their studio work, as well as for practicing architects.

Active Materials
Springer

This revised, updated and expanded new edition presents an overview of biomimetics and biologically inspired structured surfaces. It deals with various examples of biomimetics which include surfaces with roughness-induced superomniphobicity, self-cleaning, antifouling, and controlled adhesion. The focus in the book is on the Lotus Effect, Salvinia Effect, Rose Petal Effect, Oleophobic/philic Surfaces, Shark Skin Effect, and Gecko Adhesion. This new edition also contains new chapters on the butterfly wing effect, bio- and inorganic

fouling and structure and Properties of Nacre and structural coloration.

Engineered Biomimicry

Springer Nature
Bioinspired systems, technologies and techniques known as “biomimetics” or the “mimicry of nature,” represent a groundbreaking method of scientific research based on innovation and a creative design approach of the ‘nature’ laboratory to be applied to any scientific discipline. This approach and the associated way of thinking facilitates the cross-fertilization of scientific fields, integrating biology and the interdisciplinary knowledge featuring the evolution of models that have refined in nature within any scientific discipline.

Biomimicry in Architecture CRC Press

This book comprises a first survey of the Collaborative Research Center SFB-TRR 141 ‘Biological Design and Integrative Structures – Analysis, Simulation and Implementation in Architecture’, funded by the Deutsche Forschungsgemeinschaft since October 2014. The SFB-TRR 141 provides a collaborative framework for architects and engineers from the University of Stuttgart, biologists and physicists from the University of Freiburg and geoscientists and evolutionary biologists from the University of Tübingen. The programm is conceptualized as a dialogue between the disciplines and is based

on the belief that that biomimetic research has the potential to lead everyone involved to new findings far beyond his individual reach. During the last few decades, computational methods have been introduced into all fields of science and technology. In architecture, they enable the geometric differentiation of building components and allow the fabrication of porous or fibre-based materials with locally adjusted physical and chemical properties. Recent developments in simulation technologies focus on multi-scale models and the interplay of mechanical phenomena at various hierarchical levels. In the natural sciences, a

multitude of quantitative methods covering diverse hierarchical levels have been introduced. These advances in computational methods have opened a new era in biomimetics: local differentiation at various scales, the main feature of natural constructions, can for the first time not only be analysed, but to a certain extent also be transferred to building construction. Computational methodologies enable the direct exchange of information between fields of science that, until now, have been widely separated. As a result they lead to a new approach to biomimetic research, which, hopefully, contributes to a more sustainable

development in
architecture and
building construction.
Nature Inside Springer
Nature

This book provides the
readers with a timely
guide to the
application of
biomimetic principles
in architecture and
engineering design. As
a result of a combined
effort by two
internationally
recognized authorities,
the biologist Werner
Nachtigall and the
architect Göran Pohl,
the book describes the
principles which can be
used to compare
nature and technology,
and at the same time it
presents detailed
explanations and
examples showing how
biology can be used as
a source of inspiration
and “translated” in
building and
architectural solutions

(biomimicry). Even
though nature cannot
be directly copied, the
living world can
provide architects and
engineers with a
wealth of analogues
and inspirations for
their own creative
designs. But how can
analysis of natural
entities give rise to
advanced and
sustainable design? By
reporting on the latest
bionic design methods
and using extensive
artwork, the book
guides readers through
the field of nature-
inspired architecture,
offering an
extraordinary resource
for professional
architects, engineers,
designers and urban
planners, as well as for
university teachers,
researchers and
students. Natural
evolution is seen
throughout the book as

a powerful resource that can serve architecture and design by providing innovative, optimal and sustainable solutions.

Biomimetics for Designers

Createspace

Independent Publishing Platform

Emergence - the process by which new and coherent structures, patterns and properties 'emerge' from within complex systems

Traditional architecture starts from the premise that architectural structures are singular and fixed, and however well integrated are separate from their environment and context. Emergence requires that the opposite is true - that those structures are complex energy and material systems that

have a lifespan, exist as part of an environment of other active systems, and develop in an evolutionary way. This book, based on the authors' internationally renowned Emergent Technologies and Design course at the Architectural Association in London, introduces a new approach to the practice of architecture. The authors use essays and projects to demonstrate the interrelationship of concepts such as emergence and self-organisation with the latest technologies in design, manufacturing and construction. With projects from their course, and critiques and commentary from some of the world's leading design

theorists and practitioners, the authors of Emergent Technologies and Design have introduced a radical new way of understanding the way in which architecture is conceived, designed and produced.

Biomimetics in Architecture Springer Science & Business Media

Written by a leading proponent of biophilic design, this is the only practical guide to biophilic design principles for interior designers. Describing the key benefits, principles and processes of biophilic design, *Nature Inside* illustrates the implementation of biophilic design in interior design practice, across a range of international

case studies – at different scales, and different typologies. Starting with the principles of biophilic design, and the principles and processes in practice, the book then showcases a variety of interior spaces – residential, retail, workplace, hospitality, education, healthcare and manufacturing. The final chapter looks ‘outside the walls’, giving a case study at the campus and city scale. With practical guidance and real-world solutions that can be directly-applied in day-to-day practice, this is a must-have for designers interested in applying biophilic principles.

Interdisciplinary Expansions in Engineering and Design With the Power

of Biomimicry Walter de Gruyter GmbH & Co KG

The Biomimicry Resource Handbook: A Seed Bank of Best Practices contains over 250 pages of our most current biomimicry thinking, methodology, and tools for naturalizing biomimicry into the culture. We believe there is no better design partner than nature. But biomimicry is more than just looking at the shape of a flower or dragonfly and becoming newly inspired; it's a methodology that's being used by some of the biggest companies and innovative universities in the world. While reading this text you'll be immersed into the world of Biomimicry the "verb", you'll gain a

competitive edge, and a fresh perspective on how the world around us can, does, and should work. After reading the text, you'll be well on your way to thinking in systems, designing in context, identifying patterns, and most importantly seeing the millions of organisms around us....differently. The text is directly applicable to designers, biologists, engineers, entrepreneurs and intrapreneurs, but has also proven valuable to students, educators, and a wide variety of other disciplines. Visit biomimicry.net to learn more. A digital version is available at shop.biomimicrygroup.com

Architecture Follows Nature-Biomimetic Principles for

Innovative Design

Yale University Press
From simple cases such as hook and latch attachments found in Velcro to articulated-wing flying vehicles, biology often has been used to inspire many creative design ideas. The scientific challenge now is to transform the paradigm into a repeatable and scalable methodology. *Biologically Inspired Design* explores computational techniques and tools that can help integrate the method into design practice. With an inspiring foreword from Janine Benyus, *Biologically Inspired Design* contains a dozen chapters written by some of the leading scholars in the transdisciplinary field of bioinspired design, such as Frank Fish,

Julian Vincent and Jeannette Yen from biology, and Amarek Chakrabarti, Satyandra Gupta and Li Shu from engineering. Based in part on discussions at two workshops sponsored by the United States National Science Foundation, this volume introduces and develops several methods and tools for bioinspired design including: Information-processing theories, Natural language techniques, Knowledge-based tools, and Functional approaches and Pedagogical techniques. By exploring these fundamental theories, techniques and tools for supporting biologically inspired design, this volume provides a comprehensive

resource for design practitioners wishing to explore the paradigm, an invaluable guide to design educators interested in teaching the method, and a preliminary reading for design researchers wanting to investigate bioinspired design.

Biomimicry for Materials, Design and Habitats

Routledge

Biomimicry for Materials, Design and Habitats: Innovations and Applications and is a survey of the recent work of recognized experts in a variety of fields who employ biomimicry and related paradigms to solve key problems of interest within design, science, technology, and society. Topics covered include innovations from biomimicry in materials, product

design, architecture, and biological sciences. The book is a useful resource for educators, designers, researchers, engineers, and materials scientists, taking them from the theory behind biomimicry to real world applications. Living systems have evolved innovative solutions to challenges that humans face on a daily basis. Nonlinear multifunctional systems that have a symbiotic relationship with their environment are the domain of nature. Morphological solutions for buildings inspired by nature can be used for skins, surfaces, and structures to facilitate environmental adaptation of buildings to increase occupant comfort and reduce energy demands. Birds

can teach us to produce novel structures, 3D printing can be informed by oysters and mussels, and mycelium may show us the way to fabricate new biocomposites in architecture. Therefore, it is in nature that we seek inspiration for the solutions to tomorrow's challenges. Presents new directions in education and the various applications of biomimicry within industry, including bio-inspired entrepreneurship. Discusses the role of biomimicry in education, innovation, and product design. Covers applications in systems engineering and design, novel materials with applications in 3D printing, and bio-

inspired architecture. Includes perspectives on sustainability detailing the role that bio-inspiration or biomimicry plays in sustainability.

The Architecture Annual 2007-2008. Delft University of Technology

Birkhäuser

The book reflects the ideas of nineteen academic and research experts from different countries. The different sections of this book deal with epidemiological and preventive concepts, a demystification of cranio-mandibular dysfunction, clinical considerations and risk assessment of orthodontic treatment. It provides an overview of the state-of-the-art, outlines the experts' knowledge and their efforts to provide

readers with quality content explaining new directions and emerging trends in Orthodontics. The book should be of great value to both orthodontic practitioners and to students in orthodontics, who will find learning resources in connection with their fields of study. This will help them acquire valid knowledge and excellent clinical skills. *Faces of Geometry* WIT Press

Engineered Biomimicry covers a broad range of research topics in the emerging discipline of biomimicry. Biologically inspired science and technology, using the principles of math and physics, has led to the development of products as ubiquitous as Velcro™ (modeled

after the spiny hooks on plant seeds and fruits). Readers will learn to take ideas and concepts like this from nature, implement them in research, and understand and explain diverse phenomena and their related functions. From bioinspired computing and medical products to biomimetic applications like artificial muscles, MEMS, textiles and vision sensors, *Engineered Biomimicry* explores a wide range of technologies informed by living natural systems. *Engineered Biomimicry* helps physicists, engineers and material scientists seek solutions in nature to the most pressing technical problems of our times, while providing a solid

understanding of the important role of biophysics. Some physical applications include adhesion superhydrophobicity and self-cleaning, structural coloration, photonic devices, biomaterials and composite materials, sensor systems, robotics and locomotion, and ultra-lightweight structures. Explores biomimicry, a fast-growing, cross-disciplinary field in which researchers study biological activities in nature to make critical advancements in science and engineering Introduces bioinspiration, biomimetics, and bioreplication, and provides biological background and practical applications for each Cutting-edge

topics include bio-inspired robotics, microflyers, surface modification and more

Nature by Design

BoD – Books on Demand

The volume reports on interdisciplinary discussions and interactions between theoretical research and practical studies on geometric structures and their applications in architecture, the arts, design, education, engineering, and mathematics. These related fields of research can enrich each other and renew their mutual interest in these topics through networks of shared inspiration, and can ultimately enhance the quality of geometry and graphics education. Particular attention is dedicated

to the contributions that women have made to the scientific community and especially mathematics. The book introduces engineers, architects and designers interested in computer applications, graphics and geometry to the latest advances in the field, with a particular focus on science, the arts and mathematics education.

Biomimetics for Architecture & Design
Springer

This book gathers outstanding papers presented at the Conference on Automation Innovation in Construction (CIAC-2019). In recent years, there have been significant transformations in the construction sector regarding production

and the use of computers and automation to create smart and autonomous systems. At the same time, innovative construction materials and alternative technologies are crucial to overcoming the challenges currently facing the building materials industry. The book presents numerous examples of smart construction technologies, discusses the applications of new construction materials and technologies, and includes studies on recent trends in automation as applied to the construction sector.

Biomorphic Structures Five House Publishing
What are active materials? This book aims to introduce and

redefine conceptions of matter by considering materials as entities that 'sense' and respond to their environment. By examining the modeling of, the experiments on, and the construction of these materials, and by developing a theory of their structure, their collective activity, and their functionality, this volume identifies and develops a novel scientific approach to active materials. Moreover, essays on the history and philosophy of metallurgy, chemistry, biology, and materials science provide these various approaches to active materials with a historical and cultural context. The interviews with experts from the natural sciences included in this volume

develop new understandings of 'active matter' and active materials in relation to a range of research objects and from the perspective of different scientific disciplines, including biology, physics, chemistry, and materials science. These insights are complemented by contributions on the activity of matter and materials from the humanities and the design field. Discusses the mechanisms of active materials and their various conceptualizations in materials science. Redefines conceptions of active materials through interviews with experts from the natural sciences. Contextualizes, historicizes, and reflects on different notions of

matter/materials and activity through contributions from the humanities. A highly interdisciplinary approach to a cutting-edge research topic, with contributions from both the sciences and the humanities.

Regenerative Urban Design and Ecosystem Biomimicry Springer Science & Business Media

This book describes the detailed process behind the development of a comprehensive thermo-bio-architectural framework (the ThBA). This framework systematically connects the thermal performance requirements of a building to relevant solutions found in the natural world. This is the first time that

architecture has been connected to biology in this manner. The book provides an in-depth understanding of thermoregulatory strategies in animals and plants and links these to equivalent solutions in architectural design. The inclusion of this fundamental knowledge, along with the systematic process of accessing it, should open up new avenues for the generation of energy efficient and sustainable buildings. Sustainability and Automation in Smart Constructions Routledge
Applying Properties of Animals Skins to Inspire Architectural Envelopes Biology influences design projects in many ways; the related discipline is known as biomimetics

or biomimicry. Using the animal kingdom as a source of inspiration, Ilaria Mazzoleni seeks to instill a shift in thinking about the application of biological principles to design and architecture. She focuses on the analysis of how organisms have adapted to different environments and translates the learned principles into the built environment. To illustrate the methodology, Mazzoleni draws inspiration from the diversity of animal coverings, referred to broadly as skin, and applies them to the design of building envelopes through a series of twelve case studies. Skin is a complex organ that performs a multitude of functions; namely, it serves as a link

between the body and the environment. Similarly, building envelopes act as interfaces between their inhabitants and external elements. The resulting architectural designs illustrate an integrative methodology that allows architecture to follow nature. "Ilaria Mazzoleni, in collaboration with biologist Shauna Price, has developed a profound methodology for architectural and design incentives that anticipates and proposes novel ways to explore undiscovered biological inspirations for various audiences." —Yoseph Bar-Cohen [Heating with Wolves, Cooling with Cacti](#) Harper Collins This book focuses on understanding biomimetic

architecture and its role as a sustainable design tool. It presents the role of biomimicry in mitigation and adaptation to climate change and examines how biomimetic architecture can provide healthy solutions to limit the spread of COVID-19 in buildings and cities. Coverage includes global examples of biomimetic approaches and buildings, an evaluation of the performance of biomimicry applications in architecture to illustrate best practices, and an exploration of how nature can offer inspiration in building design to conserve resources and save energy use as well as curb carbon emissions - a reaffirmed goal of

COP 26 and an outcome of Glasgow Climate Pact. Finally, the book presents guidelines to enhance urban areas and healthier spaces in buildings to meet COVID-19 social distance regulations and beyond. Examines global applications of biomimicry in architecture; Highlights the importance of biomimicry in driving livability in cities and buildings; Explores the role of biomimetic architecture in mitigating climate change. "The line of argument developed is highly relevant to the present, in addition to being original and pertinent to research on urban regeneration, especially in regard to the exploration of the use of biomimicry architecture in

response to changing urban demands.”

—Alessandra Battisti, Ph.D., Professor of Architecture, University of Rome La Sapienza-
Generation GrowBots: Materials, Mechanisms, and Biomimetic Design for Growing Robots

Springer

SYNOPSIS: This book is about Design and Visual Communication for secondary school students and teachers. It is a very useful resource for primary, secondary school teachers and tertiary students, who are interested in all aspects of sustainable architecture. Designers and architects could also find it an interesting read. The software Google Sketch-up used, discussed, and illustrated in this book, is very user-friendly.

The computer-aided drawing program – SketchUpMake – is freeware, which can be downloaded from the Internet. The computer program is very easy to use; very young kids, like primary school students, and secondary school students, can use it. It is a great design program and many tertiary students, as well as professional architects and designers, make use of it. The advantage is that objects and buildings can be designed in just minutes, for example, concepts and ideas. Included in the sleep-out brief is general research (inspiration board, design eras & influential architects), and design activities that include possible solutions to a

sustainable architectural design brief. Extensive content is included on freehand sketches, SketchUp computer-aided drawings, elevations, site plans, diagrams, screenshots, biomimetics, assessments, and more. The assessment of the chosen building site is presented, including weather and climatic factors. Additionally, the author has included links to his YouTube videos (model/movement). These videos were specifically included to assist the solution to sustainable architectural briefs. Links to published academic work by the author, and much more, are also included. See Five House Publishing for more details.

Exemplars of secondary school students work (sixteen-year-olds) from a New Zealand Secondary School are included (Design and Visual Communication).
 KEYWORDS: Design and Visual Communication (DVC), Sustainable Architecture, 16-year-olds, animal architecture, armadillo and onion inspired, ask nature how, biomimetics, clerestory, climate, collecting rainwater, computer-aided software, concrete, creativity, design eras, elevations, freehand sketching, generating design ideas, green roof, harvesting energy from the sun, harvesting energy from the wind, heatsink, ideation, illustrate sustainable function,

influential designers, innovation, location, model, modernism, modernist architects, movement, New Zealand, orientation, passive solar, passive solar design, passive solar panel, passive ventilation, photovoltaic panel, primary school, retrofitting, secondary school, sectional views, Shadows and Shading, shipping container sleep-out, site assessment, site plan, Sketch-Up, sleep-out, steel reinforcing, sustainable architecture, sustainable features & functions, the living classroom, thermal mass, trombe walls, weather, climate. Biomimetics Routledge Nature has always been a source of inspiration for the design of the human

environment. The analysis of biological constructions can not only lead to astonishing technical solutions but can also inspire the design of architecture. Bionics is a fascinating border area between pure research and practical application: biologists, chemists, physicists, mineralogists, and paleontologists meet up with material scientists, engineers, and architects and transfer their knowledge to architecture and construction. Using numerous practical examples, this richly illustrated introduction traces the process from the understanding of how something functions, to abstraction—for example in computer models—and the

construction of initial
prototypes, through to

fully functional
manufacture and
production.