

Get Free Artificial
Photosynthesis
From Basic
Biology To
Industrial
Application

**Artificial Ph
otosynthesi
s From
Basic
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Application**

While the

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*sustainability of our
world is being
endangered or
destroyed by the
misguided activities
of artificial human
entities, real people
have begun to
expand their moral
sympathies
sufficiently to
prioritize protecting
our world's interests.
They have developed*

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a new technology—nanotechnology—that has the potential to advance human society toward a period of long-term sustainability, termed "the Sustainocene." This book comprises chapters by experts in various fields of nanotechnology and in related areas of

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From Basic

*governance under
the theme of how
nanotechnology can
assist in the creation
of the Sustainocene.*

*The book will appeal
to anyone involved in
nanotechnology,
macromolecular
science, public policy
related to
sustainability,
renewable energy,
and climate change.*

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This study aims to address the deficiencies of the Marcus model of electron transfer (ET) and then provide modifications to the model. A confirmation of the inverted energy gap law, which is the cleanest verification so far, is presented for donor-acceptor

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complexes. In addition to the macroscopic properties of the solvent, the physical properties of the solvent are incorporated in the model via the microscopic solvation model. For the molecules studied in this dissertation, the rate constant first

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increases with cooling, in contrast to the prediction of the Arrhenius law, and then decreases at lower temperatures.

Additionally, the polarizability of solute, which was not considered in the original Marcus theory, is included by the Q-model of ET.

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Applications

Through accounting for the polarizability of the reactants, the Q-model offers an important design principle for achieving high performance solar energy conversion materials. By means of the analytical Q-model of ET, it is shown that including molecular

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reorganization

energy and the

activation barrier of

ET reaction. The

theory and

electrochemistry of

Ferredoxin and

Cytochrome *c* are

also investigated. By

providing a new

formulation for

reaction

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*reorganization
energy, a long-
standing disconnect
between the results
of atomistic
simulations and
cyclic voltametry
experiments is
resolved. The
significant role of
polarizability of
enzymes in reducing
the activation energy
of ET is discussed.*

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*The
binding/unbinding of
waters to the active
site of Ferredoxin*

leads to non-

*Gaussian statistics of
energy gap and*

result in a smaller

activation energy of

ET. Furthermore, the

dielectric constant of

water at the

interface of neutral

and charged C60 is

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studied. The dielectric constant is found to be in the range of 10 to 22 which is remarkably smaller compared to bulk water(80).

Moreover, the interfacial structural crossover and hydration thermodynamic of charged C60 in water is studied. Increasing

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*the charge of the
C60 molecule result
in a dramatic*

Application

*structural transition
in the hydration
shell, which lead to
increase in the
population of
dangling O-H bonds
at the interface.*

*The Role of Catalysis
for the Sustainable
Production of Bio-
fuels and Bio-*

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*chemicals describes
the importance of
catalysis for the
sustainable
production of
biofuels and
biochemicals,
focused primarily on
the state-of-the-art
catalysts and
catalytic processes
expected to play a
decisive role in the
"green" production of*

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*fuels and chemicals
from biomass. In
addition, the book
includes general
elements regarding
the entire chain of
biomass production,
conversion,
environment,
economy, and life-
cycle assessment.
Very few books are
available on catalysis
in production*

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From Basic

*schemes using
biomass or its
primary conversion*

products, such as bio-

oil and lignin. This

book fills that gap

with detailed

discussions of:

Catalytic pyrolysis of

lignocellulosic

biomass Hybrid

biogasoline by co-

processing in FCC

units Fischer-

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*From Basic
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Industrial
Application*
*Tropsch synthesis to
biofuels (biomass-to-
liquid process)*

*Steam reforming of
bio-oils to hydrogen
With energy prices
rapidly rising,
environmental
concerns growing,
and regulatory
apparatus evolving,
this book is a
resource with
tutorial, research,*

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*From Basic
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Application*

*and technological
value for chemists,
chemical engineers,
policymakers, and
students. Includes
catalytic reaction
mechanism schemes
and gives a clear
understanding of
catalytic processes
Includes flow
diagrams of bench-,
pilot- and industrial-
scale catalytic*

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*From Basic
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Application*
*processing units and
demonstrates the
various process
technologies*

*involved, enabling
easy selection of the
best process*

*Incorporates many
tables, enabling easy
comparison of data
based on a critical
review of the*

available literature

The use of

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*nanomaterials in
energy conversion
and storage*

Application

*represents an
opportunity to
improve the
performance, density
and ease of
transportation in
renewable resources.*

*This book looks at
the most recent
research on the
topic, with particular*

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*focus on artificial
photosynthesis and
lithium-ion batteries
as the most
promising
technologies to date.
Research on the
broad subject of
energy conversion
and storage calls for
expertise from a
wide range of
backgrounds, from
the most*

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Application*

*fundamental
perspectives of the
key catalytic
processes at the
molecular level to
device scale
engineering and
optimization.*

*Although the nature
of the processes
dictates that
electrochemistry is a
primary
characterization tool,*

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From Basic

*due attention is given
to advanced*

Biology To

techniques such as

Industrial

synchrotron studies

Application

in operando. These

studies look at the

gap between the

performance of

current technology

and what is needed

for the future, for

example how to

improve on the

lithium-ion battery

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Application*

*and to go beyond its
capabilities. Suitable
for students and
practitioners in the
chemical,
electrochemical, and
environmental
sciences,
Nanomaterials for
Energy Conversion
and Storage provides
the information
needed to find
scalable,*

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From Basic
Biology To

*economically viable
and safe solutions for
sustainable energy.*

Application
Contents: The

*Principle of
Photoelectrochemical
Water Splitting*

*(Peiyan Ma and
Dunwei Wang)Semic
conducting*

*Photocatalysis for
Solar Hydrogen
Conversion (Shaohua*

Shen and Jie Chen)Vi

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*sible-Light-Driven
Photocatalysis*

*(Qingzhe Zhang,
Yanlong Liu, Zhenhe
Xu, Yue Zhao,*

*Mohamed Chaker
and Dongling*

*Ma)Metal-Nitride
Nanostructures:*

*Emerging Catalysts
for Artificial*

*Photosynthesis (Md
Golam Kibria, Bandar
AlOtaibi and Zetian*

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From Basic

*Microbial Surface
Engineering of*

Semiconductors for

*Photoelectrochemical
Water Splitting*

*(Gongming Wang, Yi
Yang and Yat*

*Li) Photoanodic and
Photocathodic*

*Materials Applied for
Free-Running Solar*

*Water Splitting
Devices (Miao*

Zhong, Hiroyuki

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From Basic
Biology To

(Kaneko, Taro
Yamada and
Kazunari Domen) Ele
ctrocatalytic

Processes in Energy
Technologies (Yang
Huang, Min Zeng,
Qiufang Gong and
Yanguang Li) Soft X-
Ray Spectroscopy on
Photocatalysis (Yi-
Sheng Liu, Cheng-
Hao Chuang and
Jinghua Guo) Photoel

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*Electrochemical Tools
for the Assessment of
Energy Conversion
Devices (Isaac*

*Herraiz-Cardona and
Sixto Gimenez) Funda
mentals of*

*Rechargable
Batteries and
Electrochemical
Potentials of
Electrode Materials
(Chaofeng Liu and
Guozhong*

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From Basic

*Cao)Revitalized
Interest in Vanadium
Pentoxide as Cathode*

*Material for Alkali-
Ion Batteries (Yanwei
Li, Jinhuan Yao,*

*Robert C Massé,
Evan Uchaker and*

*Guozhong Cao)Tin-
Based Compounds as
Anode Materials for*

*Lithium-Ion Storage
(Ming Zhang and
Guozhong*

Guozhong

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*Cao) Beyond Li-Ion:
Electrode Materials
for Sodium- and
Magnesium-Ion*

*Batteries (Robert
Massé, Evan
Uchaker and
Guozhong*

*Cao) Nanomaterials
and Nanostructures
for Regulating Ions
and Electron
Transport in
Advanced Energy*

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Industrial
Application

*Storage Devices (Yu
Wang and Wei-Hong
Zhong) Readership:*

*Students,
researchers and
practitioners in the
chemical,
electrochemical, and
environmental
sciences. Keywords:
Nanomaterials; Lithium-Ion Batteries; Electrochemistry; Energy Conversion; Energy*

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Biology To
Artificial
Applications

*Storage;Artificial Pho
tosynthesisReview:0*

*This book presents
photocatalysis as a
state-of-art
technology in energy
production and
conversion. The ever
increasing demand
for energy with
growing economies
has led to a dearth of
energy sources. The
exhaustive*

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From Basic

dependability on non-renewable resources of energy has not just

depleted them but also lead to the birth of secondary

problems such as pollution and climate change. The

photoactive processes have opened a new

window for the production of green

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Application*

*energy and helped in
environmental
sustainability. The
harnessing of
renewable sources
especially sun and
water for fuel
production and
noxious gases
reduction solve both
the issues of
pollution mitigation
and energy crisis.*

An introduction to

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*From Basic
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Industrial
Application*
*the fundamental
concepts and rules in
bioelectrochemistry
and explores latest
advancements in the
field*

*Bioelectrochemical
Interface
Engineering offers a
guide to this
burgeoning
interdisciplinary
field. The
authors—noted*

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*experts on the
topic—present a
detailed explanation
of the field's basic
concepts, provide a
fundamental
understanding of the
principle of
electrocatalysis,
electrochemical
activity of the
electroactive
microorganisms, and
mechanisms of*

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*electron transfer at
electrode-electrolyte
interfaces. They also
explore the design
and development of
bioelectrochemical
systems. The authors
review recent
advances in the field
including: the
development of new
bioelectrochemical
configurations, new
electrode materials,*

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*From Basic
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Application*
*electrode
functionalization
strategies, and
extremophilic
electroactive
microorganisms.*

*These current
developments hold
the promise of
powering the
systems in remote
locations such as
deep sea and extra-
terrestrial space as*

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From Basic

*well as powering
implantable energy
devices and*

*controlled drug
delivery. This*

important book: •

*Explores the
fundamental
concepts and rules in
bioelectrochemistry
and details the latest
advancements •*

*Presents principles
of electrocatalysis,*

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From Basic

*electroactive
microorganisms,*

types and

mechanisms of

*electron transfer at
electrode-electrolyte*

*interfaces, electron
transfer kinetics in*

*bioelectrocatalysis,
and more • Covers*

microbial

electrochemical

systems and

discusses

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*From Basic
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Industrial
Application*
*bioelectrosynthesis
and biosensors, and
bioelectrochemical
wastewater*

*treatment • Reviews
microbial biosensor,
microfluidic and lab-
on-chip devices,
flexible electronics,
and paper and
stretchable
electrodes Written
for researchers,
technicians, and*

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From Basic

*students in
chemistry, biology,
energy and*

*environmental
science,*

*Bioelectrochemical
Interface*

*Engineering provides
a strong foundation
to this advanced field
by presenting the
core concepts, basic
principles, and
newest advances.*

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To address the environmental, socioeconomic, and geopolitical issues associated with increasing global human energy consumption, technologies for utilizing renewable carbon-free or carbon-neutral energy sources must be identified and

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developed. Among renewable sources, solar energy is quite promising as it alone is sufficient to meet global human demands well into the foreseeable future. However, it is diffuse and diurnal. Thus effective strategies must be developed for its capture, conversion

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*From Basic Biology To
Industrial Application*
*and storage. In this
context,
photosynthesis
provides a paradigm
for large-scale
deployment.*

*Photosynthesis
occurs in plants,
algae, and
cyanobacteria and
has evolved over 3
billion years. The
process of
photosynthesis*

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*currently produces
more than 100 billion
tons of dry biomass
annually, which
equates to a global
energy storage rate
of ~100 TW.*

*Recently, detailed
structural
information on the
natural
photosynthetic
systems has been
acquired at the*

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Industrial
Application*

*molecular level,
providing a
foundation for
comprehensive
functional studies of
the photosynthetic
process. Likewise,
sophisticated
spectroscopic
techniques have
revealed important
mechanistic details.
Such
accomplishments*

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Applications*

*have made it possible
for scientists and
engineers to
construct artificial
systems for solar
energy transduction
that are inspired by
their biological
counterparts. The
book contains
articles written by
experts and world
leaders in their
respective fields and*

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summarizes the exciting breakthroughs toward understanding the structures and mechanisms of the photosynthetic apparatus as well as efforts toward developing revolutionary new energy conversion technologies. The

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topics/chapters will be organized in terms of the natural sequence of events occurring in the process of photosynthesis, while keeping a higher-order organization of structure and mechanism as well as the notion that biology can inspire human technologies.

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For example, the topic of light harvesting, will be followed by charge separation at reaction centers, followed by charge stabilization, followed by chemical reactions, followed by protection mechanisms, followed by other more specialized

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Application*

*topics and finally
ending with artificial
systems and looking
forward. As shown in
the table of contents
(TOC), the book
includes and
integrates topics on
the structures and
mechanisms of
photosynthesis, and
provides relevant
information on
applications to*

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Application*

*bioenergy and solar
energy transduction.
Highlighting the key
aspects and latest
advances in the
rapidly developing
field of molecular
catalysis, this book
covers new
strategies to
investigate reaction
mechanisms, the
enhancement of the
catalysts' selectivity*

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and efficiency, as well as the rational design of well-defined molecular catalysts. The interdisciplinary author team with an excellent reputation within the community discusses experimental and theoretical studies, along with examples of improved

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*catalysts, and their
application in
organic synthesis,
biocatalysis, and
supported
organometallic
catalysis. As a result,
readers will gain a
deeper
understanding of the
catalytic
transformations,
allowing them to
adapt the knowledge*

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to their own

Biology To

investigations. With

Artificial
its ideal combination

Application
of fundamental and

applied research,

this is an essential

reference for

researchers and

graduate students

both in academic

institutions and in

the chemical

industry. With a

foreword by Nobel

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*laureate Roald
Hoffmann.*

[Solar Power as an
Energy Source
Photosynthesis And
Bioenergetics
Nanotechnology
Toward the
Sustainocene
Pathways to Artificial
Photosynthesis
Solar Energy for Life
ARTIFICIAL
PHOTOENZYMES](#)

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[Science at the
Frontier](#)

[Handbook of
Photosensory
Receptors](#)

[Synthetic Biology](#)

[Overcoming the](#)

[Limitations of](#)

[Photosynthesis](#)

[Photocatalytic and](#)

[Photoelectrochemical](#)

[Processes](#)

**Edited by a team
of highly**

Page 59/257

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**respected
researchers**

combining their

expertise in

chemistry,

physics, and

medicine, this

book focuses on

the use of ruthen

ium-containing

complexes in

artificial

photosynthesis

and medicine.

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From Basic
Biology To

**Following a brief
introduction to**

the basic

coordination

**chemistry of ruth
enium-containing
complexes and**

**their synthesis,
as well as their
photophysical**

and

**photochemical
properties, the
authors discuss**

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From Basic
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Application

**in detail the
major concepts
of artificial
photosynthesis
and mechanisms
of hydrogen
production and
water oxidation
with ruthenium.
The second part
of the text
covers biological
properties and
important**

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medical
applications of ru
thenium-

containing

complexes as

therapeutic

agents or in

diagnostic

imaging. Aimed

at stimulating

research in this

active field, this

is an invaluable

information

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**source for
researchers in
academia, health
research**

**institutes, and
governmental
departments
working in the
field of**

**organometallic
chemistry, green
and sustainable
chemistry as well
as medicine/drug**

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Applications
**discovery, while
equally serving
as a useful
reference also
for scientists in
industry.**

**This first
complete
resource on
photosensory
receptors from
bacteria, plants
and animals
compiles the**

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data on all known classes of photoreceptors, creating a must-have reference for students and researchers for many years to come. Among the editors are the current and a former president of the American Society for

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Photobiology.
Biology To
Photosynthesis

has been an

important field

of research for

more than a

century, but the

present concerns

about energy,

environment and

climate have

greatly

intensified

interest in and

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research on this
topic. Research

has progressed
rapidly in recent

years, and this
book is an

interesting read

for an audience
who is concerned
with various

ways of

harnessing solar

energy. Our

understanding of

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**photosynthesis
can now be said
to have reached
encyclopedic
dimensions.**

**There have been,
in the past, many
good books at
various levels.**

**Our book is
expected to
fulfill the needs
of advanced
undergraduate**

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Photosynthesis
From Basic
and beginning
graduate
students in
branches of
biology,
biochemistry,
biophysics, and
bioengineering
because
photosynthesis
is the basis of
future advances
in producing
more food, more

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**biomass, more
fuel, and new**

**chemicals for our
expanding global
human**

population.

Further, the

basics of

photosynthesis

are and will be

used not only for

the above, but in

artificial

photosynthesis,

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Application

**an important
emerging field
where chemists,
researchers and
engineers of
solar energy
systems will play
a major role.**

**This technical
book explores
current and
future
applications
of solar power as**

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**an unlimited
source of energy
that earth
receives every
day.**

**Photosynthetic
organisms have
learned to
utilize this
abundant source
of energy by
converting it into
high-energy bioch
emical**

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**compounds.
Inspired by the
efficient
conversion of
solar energy into
an electron flow,
attempts have
been made
to construct
artificial
photosynthetic
systems capable
of establishing a
charge**

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**separation state
for generating
electricity or
driving chemical
reactions.**

**Another
important aspect
of photosynthesis
is the CO₂
fixation and the
production of
high energy
compounds.**

Photosynthesis

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can produce
biomass
usingsolar
energy while
reducing the CO₂
level in air.

Biomass can be
converted into
biofuels such as
biodiesel and
bioethanol.

Under certain
conditions,
photosynthetic

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**organisms can
also
produce hydroge
n gas which is
one of the
cleanest sources
of energy.**

**Semiconductors
for
Photocatalysis,
Volume 97
covers the latest
breakthrough
research and**

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From Basic
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exciting
developments in

semiconductor
photocatalysts
and electrodes
for water
splitting and CO₂
reduction. It
includes a broad
range of
materials such as
metal-oxides,
metal-nitrides,
silicon, III-V

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**semiconductors,
and the
emerging
layered
compounds. New
to this volume
are chapters
covering the
Fundamentals of
Semiconductor
Photoelectrodes,
Charge Carrier
Dynamics in
Metal Oxide**

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From Basic
Biology To
**Photoelectrodes
for Water**

**Oxidation,
Photophysics
and**

**Photochemistry
at the Semicondu
ctor/Electrolyte
Interface for
Solar Water
Splitting, V
Semiconductor
Photoelectrodes,
III-Nitride**

Page 80/257

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From Basic
Biology To

**Semiconductor
Photoelectrodes,
and Rare Earth
Containing**

**Materials for Pho
toelectrochemica
l Water Splitting
Applications. In
addition, the
design and
modeling of
photocatalysts
and
photoelectrodes**

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Application

**and the
fundamental
mechanisms of
water splitting
and CO₂**

**reduction is also
discussed.**

**Features the
latest**

**breakthroughs
and research and
development in
semiconductor
photocatalysis,**

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Application

**Covers a broad
range of topics,
including a wide
variety of
materials and
many important
aspects of solar
fuels Includes in-
depth
discussions on
materials design,**

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Biology To
growth and
synthesis,

engineering,
characterization,
and photoelectro
chemical studies

The last 30 years
has seen the
development of
increasingly
sophisticated
models that
quantify canopy
carbon

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exchange. These models are now essential parts of larger models for prediction and simulation of crop production, climate change, and regional and global carbon dynamics. There is thus an urgent need for increasing

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Application
**expertise in
developing, use
and
understanding of
these models.**

**This in turn calls
for an advanced,
yet easily
accessible
textbook that
summarizes the
“canopy science”
and introduces
the present and**

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From Basic

the future
scientists to the

theoretical

background of

the current

canopy models.

This book

presents current

knowledge of

functioning of

plant canopies,

models and

strategies

employed to

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Application

**simulate canopy
function, and the
significance of**

**canopy
architecture,
physiology and
dynamics in
ecosystems,
landscape and
biosphere.**

**Please note that
the content of
this book
primarily**

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From Basic
Biology To
Industry To
Application
**consists of
articles available
from Wikipedia
or other free
sources online.**

Pages: 45.

Chapters: 3M,

Aquanator,

Artificial

photosynthesis,

CETO,

Dysprosium,

Evopod, H-Bio,

Hybrid

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**renewable
energy system,
IEEE Smart Grid,
Joint Center for
Artificial
Photosynthesis,
NExBTL, Oyster
wave energy
converter,
Pelamis Wave
Energy
Converter,
Renewable
energy power**

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station,

Renewable heat,

Saltire Prize,

Soft energy

technology, Solar

fuel, Solar power

in Australia,

Spider9,

Vegetable oil

refining, Wells

turbine. Excerpt:

Artificial

photosynthesis

is a chemical

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Application

process that replicates the natural process of photosynthesis, a process that converts sunlight, water, and carbon dioxide into carbohydrates and oxygen. The term is commonly used

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Laboratory
Application

**to refer to any
scheme for
capturing and
storing the
energy from
sunlight in the
chemical bonds
of a fuel (a solar
fuel).**

**Photocatalytic
water splitting
converts water
into protons (and
eventually**

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Application

hydrogen) and oxygen, and is a main research area in artificial photosynthesis. Light-driven carbon dioxide reduction is another studied process, replicating natural carbon fixation.

Research

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Biology To
**developed in this
field**

**encompasses
design and
assembly of
devices (and
their
components) for
the direct
production of
solar fuels, photo
electrochemistry
and its
application in**

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Application

**fuel cells, and
engineering of
enzymes and
photoautotrophic
microorganisms
for microbial
biofuel and
biohydrogen
production from
sunlight. Many, if
not most, of the
artificial
approaches are
bio-inspired, i.e.,**

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Application

they rely on biomimetics. The photosynthetic reaction can be divided into two half-reactions (oxidation and reduction), both of which are essential to producing fuel. In plant photosynthesis, water molecules

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Biology To
are photo-
oxidized to

release oxygen
and protons. The
second stage of
plant
photosynthesis
(also known as
the Calvin-
Benson cycle) is
a light-
independent
reaction that
converts carbon

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Biology To
dioxide into
glucose.

Researchers of...

As the search for
renewable
sources of
energy grows
more urgent,
more and more
attention is
focusing on the
blueprint offered
by biological
photosynthesis

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Application

**for translating
the energy of our
Sun into energy
rich molecules
like H₂ and
carbohydrates,
commonly known
as "solar fuels."
These solar fuels
have enormous
potential to store
high densities of
energy in the
form of chemical**

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Application

**bonds as well as
being
transportable.**

**This book offers
a complete
overview of the
promising
approaches to
solar fuel
generation,
including the
direct pathways
of solar H₂
generation and**

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CO₂
photocatalytic
reduction. Solar
Fuel Generation
is an invaluable
tool for graduate
students and
researchers
(especially
chemists,
physicists, and
material
scientists)
working in this

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field.

[Artificial](#)
[Photosynthesis](#)
[A Carrefour of](#)
[Chemical](#)
[Reactivity](#)
[Traditions](#)
[Photosynthesis:](#)
[Structures,](#)
[Mechanisms, and](#)
[Applications](#)
[Electrochemical](#)
[Reduction of](#)
[Carbon Dioxide](#)

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Applications

**Proton-coupled
Electron Transfer
Oxygen
Production And
Reduction In
Artificial And
Natural Systems
Light Harvesting
in
Photosynthesis
From Molecules
to Materials
Bioelectrochemic
al Interface**

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Photosynthesis

Engineering
Design, Concepts
and Applications
Solar Fuel
Generation

This monograph
written by the
founder of the field
represents the first
and only
compilation
available in this
fascinating and

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rapidly growing
interdisciplinary
research area. A

must read for all

scientists interested

in unconventional

bio-inspired

methods available

for artificial

photosynthesis,

optogenetics,

sustainable

production

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technologies and
synthetic biology.

Biology To

Industrial
Application

This landmark
collective work
introduces the
physical, chemical,
and biological
principles
underlying
photosynthesis:
light absorption,
excitation energy
transfer, and charge

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Biology To

Industrial
Application

separation. It begins with an introduction to properties of various pigments, and the pigment proteins in plant, algae, and bacterial systems. It addresses the underlying physics of light harvesting and key

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Industrial
Application

spectroscopic
methods, including
data analysis. It
discusses assembly
of the natural
system, its energy
transfer properties,
and regulatory
mechanisms. It also
addresses light-
harvesting in
artificial systems
and the impact of

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photosynthesis on
our environment.

Biology To

Industrial
Application

The chapter authors
are amongst the
field ' s world

recognized experts.

Chapters are

divided into five

main parts, the first

focused on

pigments, their

properties and

biosynthesis, and

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the second section
looking at

Biology To

Industrial

Application

photosynthetic
proteins, including

light harvesting in

higher plants,

algae,

cyanobacteria, and

green bacteria. The

third part turns to

energy transfer and

electron transport,

discussing

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modeling
approaches,

Biology To

quantum aspects,

Industrial
Application

photoinduced
electron transfer,

and redox potential

modulation,

followed by a

section on

experimental

spectroscopy in

light harvesting

research. The

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Industrial
Application

concluding final
section includes
chapters on
artificial
photosynthesis,
with topics such as
use of
cyanobacteria and
algae for
sustainable energy
production. Robert
Croce is Head of the
Biophysics Group

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and full professor in
biology To
biophysics of photo
synthesis/energy at
Industrial
Application

Vrije Universiteit,
Amsterdam. Rienk
van Grondelle is full
professor at Vrije
Universiteit,
Amsterdam.

Herbert van
Amerongen is full
professor of
biophysics in the

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Department of
Agrotechnology
and Food Sciences
at Wageningen

University, where
he is also director of
the

MicroSpectroscopy
Research Facility.

Ivo van Stokkum is
associate professor
in the Department
of Physics and

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Biology To
Industrial
Application

Astronomy, Faculty
of Sciences, at Vrije
Universiteit,
Amsterdam.

“ Photosynthesis:
Plastid Biology,
Energy Conversion
and Carbon
Assimilation ” was
conceived as a
comprehensive
treatment touching
on most of the

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From Basic

processes

Biology To

important for

Industrial
photosynthesis.

Application
Most of the

chapters provide a

broad coverage

that, it is hoped, will

be accessible to

advanced

undergraduates,

graduate students,

and researchers

looking to broaden

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their knowledge of
Biology To
photosynthesis. For
Industrial
biologists,

biochemists, and

biophysicists, this
volume will provide

quick background
understanding for
the breadth of

issues in

photosynthesis that
are important in

research and

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From Basic
Instructional

Settings. This
Volume Will Be Of

Interest To
Advanced

Undergraduates In
Plant Biology, And
Plant Biochemistry
And To Graduate
Students And
Instructors Wanting
A Single Reference
Volume On The

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latest

Biology To

understanding of
Industrial
the critical

Application

components of

photosynthesis.

Does humanity

have a moral

obligation to

emphasise

nanotechnology's

role in addressing

the critical public

health and

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environmental
problems of our

Biology To

age? This well

Industrial
crafted book

explores this idea

by analysing the

prospects for a

macroscience nanot

echnology-for-

environmental

sustainability

project in areas

such as food, water

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Biology To
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Application

and energy supply,
medicine,
healthcare, peace
and security.

Developing and
applying an
innovative science-
based view of
natural law
underpinning a
global social
contract, it
considers some of

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From Basic

the key scientific
and governance

Biology To
Industrial

challenges such a
global project may

face. The book

concludes that the

moral culmination

of nanotechnology

is a Global Artificial

Photosynthesis

project. It argues

that the symmetric

patterns of energy

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creating
photosynthesis, life
and us are shaping

Industrial
Application

not only the
nanotechnological
advances of
artificial

photosynthesis, but
also the ethical and
legal norms likely to
best govern such
scientific

achievements to

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From Basic
Biology To
Industrial
Application

form a sustainable
existence on this
planet.

Nanotechnology for
a Sustainable World
will appeal to many
generations of
scientists and
policymakers
working to improve
our world in public
health,
environmental

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sustainability and
renewable energy
and
Industrial

Application
nanotechnology. It

will also be a

valuable resource

for similarly

motivated students

of chemistry,

physics, biology,

nanotechnology

and

photosynthesis, as

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well as

Biology To
Industrial
Application
environmental and
energy ethics, law
and policy.

Bionics means
learning from the
nature for the
development of
technology. The
science of "bionics"
itself is classified
into several
sections, from

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Biology To
Industrial
Application

materials and structures over procedures and processes until evolution and optimization. Not all these areas, or only a few, are really known in the public and also in scientific literature. This includes the Lotus-effect,

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Biology To
Industrial
Application

converted to the co
ntamination-
reduction of
fassades and the
shark-shed-effect,
converted to the
resistance-
reduction of
airplanes. However,
there are hundreds
of highly
interesting
examples that

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contain the
Biology To
transformation of
Industrial
principles of the
Application
nature into

technology. From
the large number of
these examples,
250 were selected
for the present
book according to
"prehistory", "early-
history", "classic"
and "modern time".

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Application

Most examples are new. Every example includes a printed page in a homogeneous arrangement. The examples from the field "modern time" are joint in blocks corresponding to the sub-disciplines of bionics.

Jules Verne

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Industrial
Application

(1828-1905), author
of Around the
World in Eighty
Days (1873) and
Journey to the
Center of the Earth
(1864), wrote in
1875 “ I believe
that water will one
day be used as a
fuel, because the
hydrogen and
oxygen which

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Industrial
Application

constitute it, used separately or together, will furnish an inexhaustible source of heat and light. I therefore believe that, when coal (oil) deposits are oxidised, we will heat ourselves by means of water.

Water is the fuel of

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From Basic

the future ” Solar
Biology To
energy is the only
Industrial
renewable energy
Application
source that has

sufficient capacity
for the global
energy need; it is
the only one that
can address the
issues of energy
crisis and global
climate change. A
vast amount of

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Application

solar energy is harvested and stored via photosynthesis in plants, algae, and cyanobacteria since over 3 billion years. Today, it is estimated that photosynthesis produces more than 100 billion tons of dry biomass

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Application

annually, which would be equivalent to a hundred times the weight of the total human population on our planet at the present time, and equal to a global energy storage rate of about 100 TW.

The solar power is the most abundant

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source of
renewable energy,
and oxygenic

photosynthesis
uses this energy to
power the planet
using the amazing
reaction of water
splitting. During
water splitting,
driven ultimately by
sunlight, oxygen is
released into the

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atmosphere, and
this, along with

food production by
photosynthesis,

supports life on our
earth. The other
product of water
oxidation is

“ hydrogen ”

(proton and
electron). This

‘ hydrogen ’ is not
normally released

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into the

Biology To

atmosphere as

hydrogen gas but

combined with

carbon dioxide to

make high energy

containing organic

molecules. When

we burn fuels we

combine these

organic molecules

with oxygen. The

design of new solar

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energy systems

Biology To

must adhere to the
same principle as

Industrial
Application

that of natural

photosynthesis. For

us to manipulate it

to our benefit, it is

imperative that we

completely

understand the

basic processes of

natural

photosynthesis,

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Biology To
Industrial
Application

and chemical conversion, such as light harvesting, excitation energy transfer, electron transfer, ion transport, and carbon fixation.

Equally important, we must exploit application of this knowledge to the development of

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Biology To
Industrial
Application

fully synthetic
and/or hybrid
devices.

Understanding of
photosynthetic
reactions is not only
a satisfying
intellectual pursuit,
but it is important
for improving
agricultural yields
and for developing
new solar

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From Basic

technologies.

Biology To

Industrial

Application

knowledge of the
working of

photosynthesis and

its photosystems,

including the water

oxidation reaction.

Recent advances

towards the

understanding of

the structure and

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Biology To
Industrial
Application

the mechanism of the natural photosynthetic systems are being made at the molecular level. To mimic natural photosynthesis, inorganic chemists, organic chemists, electrochemists, material scientists, biochemists,

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From Basic
Biology To
Industrial
Application

biophysicists, and
plant biologists
must work together
and only then
significant progress
in harnessing
energy via

“ artificial
photosynthesis ”
will be possible.

This Research Topic
provides recent
advances of our

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From Basic

understanding of
Biology To
photosynthesis,

Industrial
Application
gives to our readers
recent information

on photosynthesis
research, and

summarizes the

characteristics of

the natural system

from the standpoint

of what we could

learn from it to

produce an efficient

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artificial system, i.e.,
Biology To
from the natural to

Industrial

the artificial. This
Application
topic is intended to

include exciting

breakthroughs,

possible limitations,

and open questions

in the frontiers in

photosynthesis

research.

This book is the

outcome of a

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Biology To
Industrial
Application

Bioenergetics
workshop held at
Nanyang

Technological
University (NTU),
Singapore in April
2018 to honour
Professor Bertil
Andersson for his
outstanding
contributions to
scientific research
and administration,

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particularly his very
successful 11 years

a NTU as Provost
(2007-2011) and

President

(2011-2018). The

main focus of the

book is on the

mechanisms of

photosynthetic

oxygen production

by water splitting

and the reverse

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respiratory reaction
of oxygen reduction

to water. Also

discussed is how

these reactions can

be used for the

development of

artificial

photosynthesis for

the generation of

sustainable solar

fuel. The various

chapters are written

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Industrial

Application

Rudolph Marcus

and John Walker.

They provide the
very latest

knowledge of how
the flow of energy
in biology is driven
by sunlight and
efficiently utilized
to power life. This

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book is suitable for
students and

researchers who are
interested in

molecular details of
energy flow on our

planet and also

concerned about

sustainability of

humankind.

Artificial

Photosynthesis, the

latest edition in the

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Advances in
Botanical Research

series, which

publishes in-depth

and up-to-date

reviews on a wide

range of topics in

the plant sciences

features several

reviews by

recognized experts

on all aspects of

plant genetics,

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biochemistry, cell
biology, molecular
biology, physiology,
and ecology.

Publishes in-depth
and up-to-date
reviews on a wide
range of topics in
plant sciences

Presents the latest
information on
artificial
photosynthesis

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Features a wide
range of reviews by
recognized experts

on all aspects of

plant genetics,
biochemistry, cell
biology, molecular
biology, physiology,
and ecology

[Energy Conversion](#)

[and Chemical](#)

[Transformations](#)

[Nanotechnology for](#)

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[Energy Conversion](#)
[in Natural and](#)
[Artificial](#)
[Photosynthesis](#)
[Faraday Discussion](#)
[215](#)
[Nanomaterials For](#)
[Energy Conversion](#)
[And Storage](#)
[Molecular Solar](#)
[Fuels](#)

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Biomedical](#)

[Industrial
Applications](#)

[Advances in](#)

[Cyanobacterial](#)

[Biology](#)

[Solar-to-Chemical](#)

[Conversion](#)

[Semiconductors for](#)

[Photocatalysis](#)

This

interdisciplinary

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book focuses on the

Biology To

various aspects

Industrial

transformation of the
Application
energy from sunlight

into the chemical

bonds of a fuel,

known as the

artificial

photosynthesis, and

addresses the

emergent challenges

connected with

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growing societal

Biology To

demands for clean

Industrial

and sustainable

Application

energy technologies.

The editors assemble
the research of world-
recognized experts
in the field of both
molecular and
materials artificial
systems for energy
production.

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Biology To
Industrial
Application

Contributors cover the full scope of research on photosynthesis and related energy processes.

Photosynthesis is one of the most important reactions on Earth, and it is a scientific field that is intrinsically

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interdisciplinary,

Biology To

with many research
Industrial
groups examining it.

Application

We could learn

many strategies from

photosynthesis and

can apply these

strategies in artificial

photosynthesis.

Artificial

photosynthesis is a

research field that

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Application

attempts to replicate
the natural process
of photosynthesis.

The goal of artificial
photosynthesis is to
use the energy of the
sun to make
different useful
material or high-
energy chemicals for
energy production.
This book is aimed

Get Free Artificial Photosynthesis

From Basic

at providing
Biology To

fundamental and

Industrial
applied aspects of

Application
artificial

photosynthesis. In

each section,

important topics in

the subject are

discussed and

reviewed by experts.

One of the crucial

challenges in the

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Application

energy sector is the efficient capture and utilisation of CO₂ generated from fossil fuels. Carbon capture and storage technologies can provide viable alternatives for energy intensive processes, although implementation of

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large-scale
demonstrators

Biology To

Industrial

remains challenging.

Application

Therefore,

innovative

technologies are

needed that are

capable of

processing CO₂

emission from a

wide range of

sources, ideally

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Industrial
Application

without additional
fossil energy
demand (e.g. solar
driven or

overcoming the
limits of
photosynthesis).

This book covers the
most recent
developments in the
field of
electrochemical

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From Basic
Biology To
Industrial
Application
reduction of CO₂,
from first-principle
mechanistic studies
to technological

perspectives. An
introduction to basic
concepts in
electrochemistry and
electrocatalysis is
included to provide a
background for
newcomers to this

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field. This book provides a comprehensive overview for researchers and industrial chemists working in environmental science, electrochemistry and chemical engineering.

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This volume brings
together research
from scientists with
a broad set of

expertise, aiming to
find consensus on
priorities in the
future development
of artificial
photosynthesis
research.

This comprehensive

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Industrial
Application

book systematically
covers the
fundamentals in
solar energy

conversion to
chemicals, either
fuels or chemical
products. It includes
natural
photosynthesis with
emphasis on
artificial processes

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Industrial
Application

for solar energy
conversion and
utilization. The
chemical processes
of solar energy
conversion via
homogeneous and/or
heterogeneous
photocatalysis has
been described with
the mechanistic
insights. It also

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consists of reaction

Biology To

systems toward a

Industrial

variety of

Application

applications, such as

water splitting for

hydrogen or oxygen

evolution,

photocatalytic CO₂

reduction to fuels,

and light driven N₂

fixation, etc. This

unique book offers

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Application

the readers a broad
view of solar energy
utilization based on
chemical processes
and their

perspectives for
future sustainability.

Proton-coupled
electron transfer
(PCET) is emerging
as an important new
class of reactions

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and, over the past

Biology To

decade, great strides

Industrial

have been made in

Application

our understanding of

them. PCET

reactions are studied

in many branches of

chemistry and are

omnipresent in

biological processes.

This book covers

recent developments

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From Basic
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Industrial
Application

from both the
theoretical and
experimental points
of view. It

concentrates on the
importance of PCET
in biological systems
and for bioenergetic
conversion. The
oxidation of water in
Photosystem II to
produce oxygen, and

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Industrial
Application

the reduction of protons to hydrogen by hydrogenase, for energy storage gets particular emphasis. Chemical reactivity is currently explained in terms of several scientific principles. One of them is the bond-breaking-bond-forming

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process and is

Biology To

conceptually based

Industrial

on potential energy

Application

surfaces. Another

incorporates the role

of Franck-Condon

factors resulting

from the overlap of

vibrational

wavefunctions. A

third, the so-called

solvent

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Industrial
Application

reorganization,
involves solvent
configuration around
a charged species.

PCET brings
together such
concepts and links
them to quantum
mechanical
tunnelling of the
electron particle.
This book uses

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Industrial
Application

personal accounts of
experimental
examples to provide
additional insight on
this important topic.

It starts by
presenting a general
overview of the
main theoretical
approaches and
experimental
applications. The

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Application

chapters then go on
to cover topics
including: the
application of the
Marcus Cross
Relation; the
solvation of ionic
systems;
experimental
approaches in
biological redox
systems; metal ion-

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Application

coupled electron
transfer, and
electrochemical
concerted proton-
electron transfers.

Edited by pioneers
in this exciting field,
and featuring
contributions from
leading researchers,
this book discusses
the principles and

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Industrial
Application

applications of
XFELs.

The classic and
authoritative

textbook, *Molecular
Mechanisms of
Photosynthesis*, is
now fully revised
and updated in this
much-anticipated
second edition.

Whilst retaining the

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Industrial
Application

first edition's clear
writing style and
accessible
description of this
complex process,
updates now include
cutting-edge
applications of
photosynthesis, such
as to bioenergy and
artificial
photosynthesis as

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well as new

Biology To

analytical

Industrial

techniques. Written

Application

by a leading

authority in

photosynthesis

research, this new

edition is presented

in full color with

clear, student-

friendly illustrations.

An interdisciplinary

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approach to

Biology To

photosynthesis is

Industrial

taken, with coverage

Application

including the basic

principles of energy

storage, the history

and early

development of

photosynthesis,

electron transfer

pathways, genetics

and evolution. A

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comprehensive
Biology To
appendix, containing
Industrial
an introduction to
Application
the basic chemical
and physical
principles involved
in photosynthesis, is
also included.

Molecular
Mechanisms of Phot
osynthesis, second
edition, is an

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indispensable text
for all students of
plant biology,
bioenergy, and
molecular biology,
in addition to
researchers in these
and related fields
looking for an
accessible
introduction to this
vital and integral

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process to life on
earth. stresses an
interdisciplinary
approach

emphasizes recent
advances in
molecular structures
and mechanisms
includes the latest
insights and research
on structural
information,

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improved techniques
as well as advances
in biochemical and
genetic methods

comprehensive
appendix, which
includes a detailed
introduction to the
physical basis of
photosynthesis,
including
thermodynamics,

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spectroscopy

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with downloadable
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Assimilation

Nanophotocatalysis

and Environmental

Applications

Bionics by Examples

Renewable Energy

Technology

Since the events
crucial to plant
photosynthesis
are now known in

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detail, this process is no longer nature's secret, but can for the first time be mimicked by technology. Broad in its scope, this book spans the basics of biological photosynthesis right up to the

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current
Biology To
approaches for
Industrial
its technical
Application,
exploitation,
making it the
most complete
resource on
artificial
photosynthesis
ever published.
The contents
draw on the
expertise of the
Australian

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Biology To
Photosynthesis
Network,

Application
currently the
world's largest
coordinated
research effort
to develop
effective
photosynthesis
technology. This
is further
backed by expert
contributions

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Application

from around the
globe, providing
an authoritative
overview of
current research
worldwide.

This book is a
tribute to three
outstanding
scientists,
Professors Jan
Anderson FRS,
Leslie Dutton
FRS and John

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Walker FRS,
Nobel Laureate.

Covering some of
the most recent
advances in the
fields of
Bioenergetics
and
Photosynthesis,
this book is a
compilation of
contributions
from leading
scientists

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actively

Biology To

involved in

Industrial

understanding

the natural

biological

processes

associated with

the flow of

energy in

biological

cells. The

lectures found

in this

significant

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volume were

Biology To

presented at a

meeting in March

Application
2016 in

Singapore to

commemorate the

outstanding

research in this

area. The

contents begin

with the ideas,

specially the

contribution

from Nobel

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Laureate Rudolph
Biology To
Marcus, who is

well-known for

Industrial
creating the

Application
theory of

electron

transport

reactions. This

is followed by

contributions of

many others on

various aspects

of respiratory

and

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photosynthetic
transport chains
as well as the
dynamic
regulation of
light harvesting
and electron
transport events
in oxygenic
photosynthesis.
The book is
highly
recommended to
postgraduate

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students and
researchers who
are interested
in various
aspects of
bioenergetic
cycles.

Contents:

Maquette

Strategy for

Creation of

Light- and Redox-

Active Proteins

(Nathan M

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Ennist, Joshua A
Mancini, Dirk B

Auman, Chris

Bialas, Martin J

Iwanicki,

Tatiana V

Esipova, Bohdana

M Discher,

Christopher C

Moser and P

Leslie Dutton)

Free, Stalled,

and Controlled

Rotation Single

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Molecule
Biology To
Experiments on
F1-ATPase and
Industrial
Their
Application
Relationships
(Sándor Volkán-
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Rudolph A
Marcus) The Role
of the H-Channel
in Cytochrome c
Oxidase: A
Commentary
(Mårten

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Wikström)

Cytochrome c
Oxidase: Insight

into Functions
from Studies of
the Yeast S

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Homologue (Peter
R Rich)

Femtosecond
Infrared
Crystallography
of Photosystem
II Core

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Complexes :

Watching Exciton
Dynamics and

Application

Separation in

Real Space and

Time (Marius

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Thor)

Bioenergetics,

Water Splitting

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Industrial
Application
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Molecular
Chiropractor of
the World's Most

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Abundant Protein
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Shivhare and

Oliver Mueller-

Cajar) Adaptive

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Ruban) Thylakoid

Membrane

Dynamics in

Higher Plants

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Koochak, Meng Li
and Helmut
Kirchhoff)

Oxygenic

Photosynthesis –
Light Reactions
within the Frame
of Thylakoid
Architecture and
Evolution (Sari
Järvi, Marjaana
Rantala and Eva-
Mari Aro)

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Estimation of
the Cyclic

Biology To
Electron Flux

Industrial
Application
Around

Photosystem I in

Leaf Discs

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Duncan

Fitzpatrick, Da-

Yong Fan,

Shunichi

Takahashi,

Riichi Oguchi

and Wah Soon

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Chow) The
Biology To
Contribution of
Electron

Transfer After
Application
Photosystem I to
Balancing

Photosynthesis
(Guy Hanke and
Renate Scheibe)
Cyclic Electron
Flow in

Cyanobacteria
and Eukaryotic
Algae (A W D

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Biology To
Industrial
Application
Larkum, M Szabo,
D Fitzpatrick
and J A Raven)

Readership:

Postgraduate
students,
researchers and
specialists
interested in
various aspects
of respiratory
and
photosynthetic
electron

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transport
chains. To

Keywords: Bioene
rgetics; Photosyn
thesis; Electron
Transport
Chains; Light Har
vesting; Microsco
py; Spectroscopy;
Femtosecond Crys
tallography
Review: 0

Synthetic
Biology provides

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a framework to
examine key
enabling

components in
the emerging
area of
synthetic
biology.

Chapters
contributed by
leaders in the
field address
tools and
methodologies

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developed for
engineering
biological
systems at many
levels,
including
molecular,
pathway,
network, whole
cell, and multi-
cell levels. The
book highlights
exciting
practical

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applications of
synthetic
biology such as
microbial
production of
biofuels and
drugs,
artificial
cells, synthetic
viruses, and
artificial
photosynthesis.
The roles of
computers and

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computational
design are

discussed, as

well as future

prospects in the

field, including

cell-free

synthetic

biology and

engineering

synthetic

ecosystems.

Synthetic

biology is the

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design and
Biology To
construction of
Industrial
new biological
Application, such
as enzymes,
genetic
circuits, and
cells, or the
redesign of
existing
biological
systems. It
builds on the
advances in

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molecular, cell,
Biology To
and systems
biology and
Application
seeks to
transform
biology in the
same way that
synthesis
transformed
chemistry and
integrated
circuit design
transformed
computing. The

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element that
Biology To
distinguishes

synthetic

biology from

traditional

molecular and

cellular biology

is the focus on

the design and

construction of

core components

that can be

modeled,

understood, and

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tuned to meet
specific
performance
criteria and the
assembly of
these smaller
parts and
devices into
larger
integrated
systems that
solve specific
biotechnology
problems.

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Biology To
contributions

from leaders in

the field

presents

examples of

ambitious

synthetic

biology efforts

including

creation of

artificial cells

from scratch,

cell-free

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synthesis of
chemicals,

Biology To
fuels, and

Application
proteins,

engineering of

artificial

photosynthesis

for biofuels

production, and

creation of

unnatural living

organisms

Describes the

latest state-of-

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the-art tools
developed for

Biology To
Industrial

Application

ever-increasing
sizes of DNA and
efficient

modification of
proteins,

pathways, and
genomes

Highlights key
technologies for
analyzing

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From Basic
Biological

systems at the
genomic,
proteomic, and

metabolomic
levels which are

especially
valuable in

pathway, whole
cell, and multi-
cell

applications

Details

mathematical

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modeling tools
and
computational
tools which can
dramatically
increase the
speed of the
design process
as well as
reduce the cost
of development.
Written by
experts, this
book presents

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the latest
Biology To
knowledge and

Industrial

prospects in
Application

developing

hydrogen as a

solar fuel.

This book

discusses the

basic principles

and processes of

solar energy

conversion in

natural

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photosynthesis.

Biology To

It then directly

Industrial
compares them

Application
with recent

developments and

concepts

currently being

pursued in

artificial

photosynthetic

systems that are

capable of

utilizing

sunlight to

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convert carbon dioxide and water into a chemical fuel. In this regard, the main focus is on photoelectrochemical cells, in which semiconducting photoanodes and -cathodes modified with (electro-)

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Biology To
Industrial
Application

catalysts are

used to oxidize

water, produce

hydrogen and

reduce carbon

dioxide in a

monolithic

device. The

fundamental

photochemical

and

photophysical

processes

involved are

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presented and
discussed, along
with protection
mechanisms and
efficiency
calculations for
both natural and
artificial
photosynthesis.
In turn, key
parameters that
are crucial for
the efficient
operation of

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From Basic

natural
photosynthesis
are identified.

Lastly, their
validity and
applicability in
the design of
artificial solar-
driven water-
splitting
systems are
examined.

Advances in
Cyanobacterial

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Biology presents
the novel,
practical, and
theoretical
aspects of
cyanobacteria,
providing a
better
understanding of
basic and
advanced
biotechnological
application in
the field of

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Industrial
Application
sustainable
agriculture.

Chapters have
been designed to
deal with the
different
aspects of
cyanobacteria
including their
role in the
evolution of
life,
cyanobacterial
diversity and

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From Basic
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Application
classification,
isolation, and
characterization
of cyanobacteria
through

biochemical and
molecular
approaches,
phylogeny and
biogeography of
cyanobacteria,
symbiosis,
Cyanobacterial
photosynthesis,

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Biology To

morphological
and

physiological
Application to

abiotic

stresses, stress-
tolerant

cyanobacterium,
biological

nitrogen

fixation. Other

topics include

circadian

rhythms,

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genetics and
Biology To
molecular
biology of
Abiotic stress
Application
responses,
application of
cyanobacteria
and
cyanobacterial
mats in
wastewater
treatments, use
as a source of
novel stress-

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responsive genes

Biology To

for development

Industrial

of stress

Application and as

a source of

biofuels,

industrial

application, as

biofertilizer,

cyanobacterial

blooms, use in

Nano-technology

and

nanomedicines as

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well as
Biology To
potential
Industrial
applications.

This book will
be important for
academics and
researchers
working in
cyanobacteria,
cyanobacterial
environmental
biology,
cyanobacterial
agriculture and

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cyanobacterial
molecular
biologists.**

**Summarizes the
various aspects
of
cyanobacterial
research, from
primary nitrogen
fixation, to
advanced nano-
technology
applications
Addresses both**

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practical and
theoretical

aspects of the

cyanobacterial

application

Includes

coverage of

biochemical and

molecular

approaches for

the

identification,

use and

management of

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cyanobacteria
Biology To
Science at the
Frontier takes
you on a journey
Application
through the
minds of some of
the nation's
leading young
scientists as
they explore the
most exciting
areas of
discovery today.
Based on the

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Biology To
second Frontiers
of Science

symposium

sponsored by the
National Academy
of Sciences,

this book

describes recent
accomplishments

and new

directions in

ten basic

fields,

represented by

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outstanding
scientists
convening to
discuss their
research. It
captures the
excitement and
personal quality
of these
exchanges,
sometimes
pointing to
surprising
connections

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spanning the
boundaries of

traditional

disciplines,

while providing

a context for

the reader that

explains the

basic scientific

framework for

the fields under

discussion. The

volume explores

New

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modifications to
Biology To
scientific

theory as

Application
geologists probe

deep inside the

earth and

astrophysicists

reach to the

limits of the

observable

universe for

answers to some

of nature's most

fundamental and

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vexing
questions. The
influence of
research in smog
formation on the
public debate
about how to
effectively
control air
pollution. The
increasing use
of computer
modeling in
science, from

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describing the
evolution of

Biology To
cellular

Industrial
automata to

revealing the

workings of the

human brain via

neural networks.

The rise of

dynamical

systems (the

study of chaotic

behavior in

nature) to a

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Biology To
full-fledged
science. The

search to

understand the

regulation of

gene activity

and the many

biological

problems--such

as the onset of

cancer--to which

it applies.

Recent progress

in the quest to

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transform what we know about photosynthesis into functional, efficient systems to tap the sun's energy. Current developments in magnetic resonance imaging and its promise for new breakthroughs in

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medical
diagnosis.

Throughout this
work the reader
is witness to
scientific
discovery and
debate centered
on such common
concerns as the
dramatic and
transforming
effect of
computers on

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scientists'
Biology To
thinking and

research; the

development of

more cross-

disciplinary

perspectives;

and the very

nature of the

scientific

enterprise

itself--what it

is to be part of

it, and its

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significance for
society. Science
at the Frontier
is must reading
for informed lay
readers,
scientists
interested in
fields other
than their own,
and science
students
considering a
future

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specialization.

Global

Artificial

Photosynthesis

as

Nanotechnology's

Moral

Culmination

Structure and

Functional

Design

Temperature and

Polarizability

Effects on

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Transfer in
Biology and
Artificial
Photosynthesis
Molecular
Mechanisms of
Photosynthesis
Natural and
Artificial
Photosynthesis
The Role of
Catalysis for
the Sustainable

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Production of
Bio-fuels and

Bio-chemicals

From Basic

Biology to

Industrial

Application

Current

challenges in

photosynthesis:

From natural to

artificial

Applications in

Materials,

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From Basic
Chemistry and
Biology To
3M, Aquanator,
Artificial
Photosynthesis,
Ceto,
Dysprosium,
Evopod, H-Bio,
Hybrid Renewable
Energy System,
Ieee Smart Gri