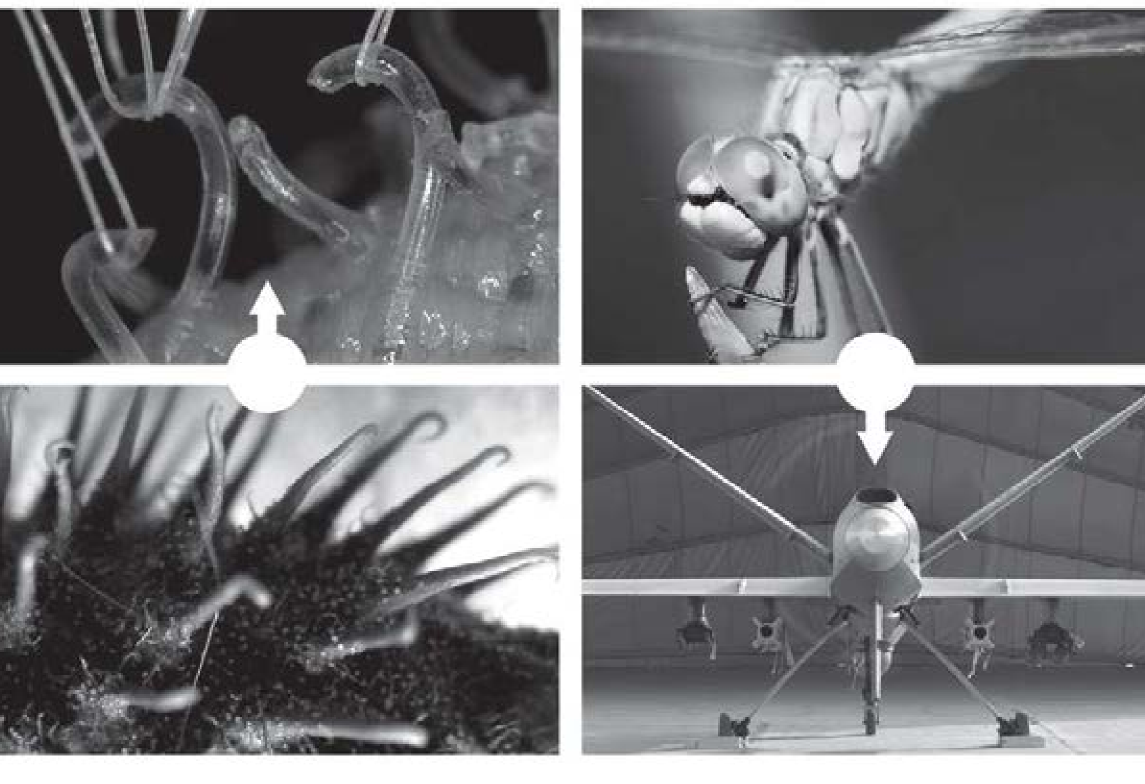
Donald DeYoung & Derrik Hobbs

Discovery of Design

Searching Out the Creator's Secrets



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This *Discovery of Design* is dedicated to our wives, Sally DeYoung and Jessica Hobbs. We thank God for their faithful companionship and love.

— Don B. DeYoung and Derrik Hobbs

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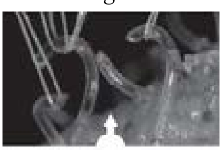

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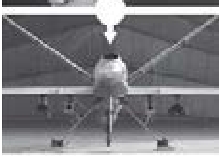

USAF Hunter-Killer Reaper UAV
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In crossing a heath, suppose I pitched my foot against a stone, and were asked how the stone came to be there: I might possibly answer, that for any thing I know to the contrary, it had lain there for ever: nor would it perhaps be very easy to show the absurdity of this answer. But suppose I had found a watch upon the ground, and it should be inquired how the watch happened to be in that place; I should hardly think of the answer which I had before given, that for any thing I knew, the watch might have always been there. Yet why should not this answer serve for the watch, as well as for the stone? Why is it not as admissable in the second case as in the first? For this reason, and for no other, viz., that when we come to inspect the watch, we perceive (what we could not discover in the stone) that its several parts are framed and put together for a purpose. . . . This mechanism being observed . . . the inference, we think, is inevitable, that the watch must have had a maker; that there must have existed, at some time, and at some place or other, an artificer or artificers, who formed it for the purpose which we find it actually to answer; who comprehended its construction, and designed its use.

— William Paley
Natural Theology, 1802

INTRODUCTION

Inventors and design engineers frequently look to nature for inspiration. There they find countless insights for new products and procedures. This book describes many of the useful results from this ongoing search. Nature is indeed a master teacher of design. And as a bonus, the products and designs found in nature arise from common, biodegradable materials. The name *biomimicry* is often given to this endeavor of discovering and utilizing designs from nature. Biomimicry and related words are defined in the glossary.

There are two distinct explanations for the host of successful ideas derived from nature studies. First, some people conclude that credit belongs to millions of years of evolutionary change. Over time, beneficial features in living things are said to be fine-tuned and optimized, while those organisms that are less fit are weeded out and eliminated. It is to be expected, some say, that exquisite designs are found throughout nature. After all, there have been millions of generations of trial and error to get it right. In this view, the brilliant tail of the peacock survives because earlier peacocks with short, drab tails failed in the competition to pass their genes on to later generations. There is, however, one major flaw with this natural explanation of design: it simply does not work. Patterns and information are conserved with the passing of generations, but the DNA blueprint does not increase in complexity or gain new information. A beautiful peacock tail does not gradually develop from fish scales, or from a knobby skin protrusion, or even from a short, drab tail. The occurrence of genetic mutations, including the occasional production of new species, actually displays an unavoidable loss or limitation of the earlier information content. Many scholars conclude that there is no convincing natural explanation for the peacock's tail or for any other design feature in living plants and animals.

There is a second explanation for the useful innovations found throughout nature. This alternative approach suggests a complete reversal of evolutionary progress over countless generations. It proposes that the valuable, practical design ideas surrounding us have been present from the very beginning of time. That is, useful features were embedded in the material universe by supernatural acts of creation. The purpose was for the benefit of living things, and also that ideas could be discovered and utilized for the welfare of mankind. In addition, design examples show us how to properly care for nature and maintain its health. Clearly, this explanation assumes intelligent planning by a beneficient Creator. Some might object that a divine hand in nature is not allowed. After all, today's science enterprise limits itself to naturalistic explanations for everything with no outside intervention. However, the historic definition of science is the search for knowledge and truth about the physical world, wherever this may lead. Regarding design in nature, the path of inquiry points directly to an intelligent plan.

Of special note is the book's eighth chapter regarding design found in nonliving parts of nature. Such items cannot somehow mutate or improve themselves over time. They have been present always. Also, chapter 7 describes some of the many medical benefits derived from plants and animals. Following each book entry there are questions for further study. Answers are provided at the end of the book. We also include a glossary of terms and a bibliography of biomimicry resources.

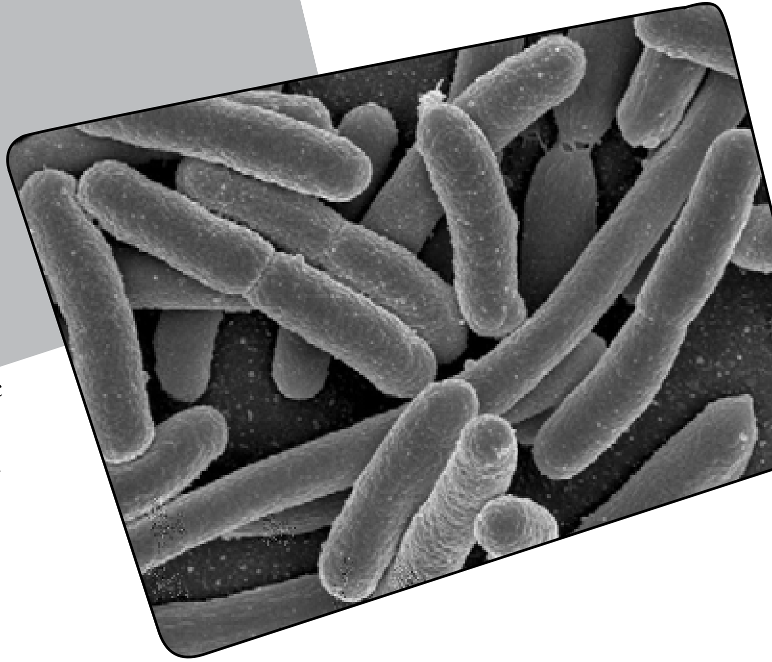
The authors of this book, along with many others, find the creation approach to origins and history to be a compelling and satisfying worldview. Readers are challenged to consider for themselves the alternate explanations for the limitless designs discovered in nature, and their implications. Explore new design at the website DiscoveryofDesign.com, and send us new examples and ideas for this growing database.

1 MICROORGANISMS

The microscopic world was explored in recent centuries by pioneer scientists such as Antonie van Leeuwenhoek (1632–1723). This Dutch pioneer built early microscopes and observed what he called “little animals.” The world of microorganisms is crowded: living bacteria on your skin far outnumber the entire U.S. population. This small-scale life is neither primitive nor simple. Just the opposite. These tiny plants and animals reveal advanced designs for our study and benefit.

In the year of 1657 I discovered very small living creatures in rain water.

— Antonie van Leeuwenhoek



Bacteria Micro-motor

Many microscopic forms of life propel themselves through liquids using built-in protein assemblies called molecular motors. The organisms include certain bacteria and mitochondria, which exist within most living cells. The motor is in the form of a rapidly spinning filament called a flagellum, which functions much like a ship's propeller. A central shaft made of protein material spins as rapidly as 100,000 revolutions per minute (rpm), and is controlled by complex electrochemical reactions. These amazing "living motors" are able to stop and reverse their direction of turning in less than one rotation. Such flexibility is far beyond any manmade motor. Ten million of these molecular motors would fit along a one-inch length.

Cornell University researchers have succeeded in integrating molecular motors with metallic microspheres so that the bacteria transport the spheres through fluids. Future research goals include the use of the molecular machines as internal mobile pharmacies that deliver drugs exactly where needed within the body. *Discover* magazine describes these self-propelled bionic machines as one of the most promising emerging technologies.

As an alternative means of movement, consider the micrometer-size myxobacteria. This organism has hundreds of tiny nozzles covering its outer surface. It manufactures a slime that shoots from these nozzles,

much like silly string. As a result, the bacterium recoils in the opposite direction using the principle of jet propulsion. The recoil speed exceeds ten micrometers per second. This is equivalent to a person traveling at 20 miles per hour, comparable to a swift runner. There are plans to duplicate this propulsion mechanism to control the movement of mechanical nanoscale devices within the human body.

References

Goho, Alexandra. 2004. Mini motor. *Science News* 165(12):180.

Merali, Zeeya. April 1, 2006. Bacteria use slime jets to get around. *New Scientist* 192 (2545):15.

Questions for further study

1. What is the precise meaning of the words *micro* and *nano*?
2. How does the speed of an electric fan compare with the 100,000 rpm rate of the molecular motor?
3. What are the chemical properties of silly string?

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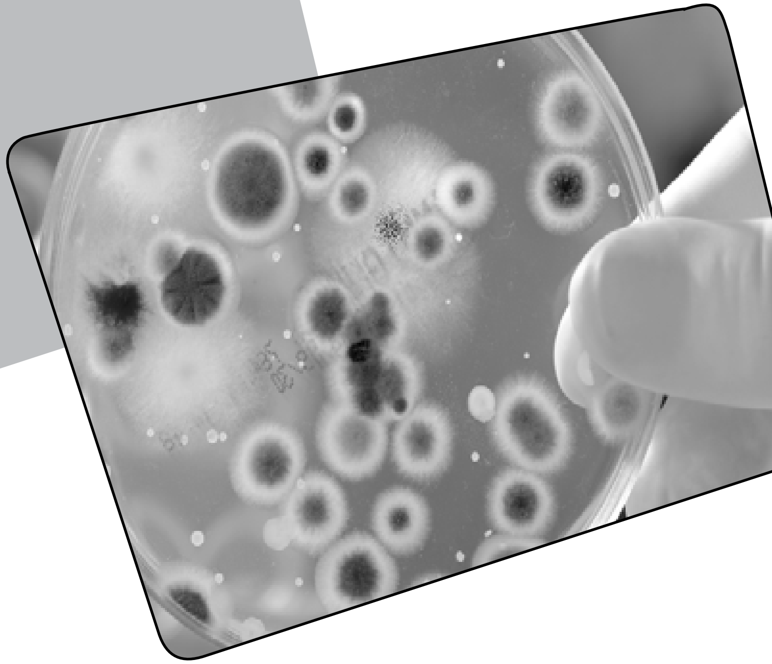

Bacteria ⇨ Battery

Scientists have taken a special interest in a bacterium called *Rhodoferax ferrireducens,* which resides in marine sediments. This tiny microbe produces electrical current using simple sugars as its fuel source. The bacterium feeds on the sugars, and a steady flow of freed electrons results. Waste materials are the bacteria's favorite diet. Sugars include fructose from fruit, xylose from wood, sucrose from sugar cane and beets, and glucose from many other sources. The electric energy production of the bacterium is more than 80 percent efficient, far above that of other organisms and man-made energy conversion processes.

Energy-producing microorganisms are known as bacterial batteries, or fuel cells. The technological challenge is to combine the electric output from a large number of these bacteria to produce a practical level of current. If successful, one cup of common sugar could light a 60-watt

bulb for many hours. This organic power source would be especially useful where the importing of fuel is difficult, such as remote villages. In such locations, the specialized bacteria could consume vegetation and turn the lights on.

Questions for further study

1. What actually is a battery?
2. Why are most energy conversion processes inefficient?
3. How many electrons pass through a standard 60-watt light bulb in one second?

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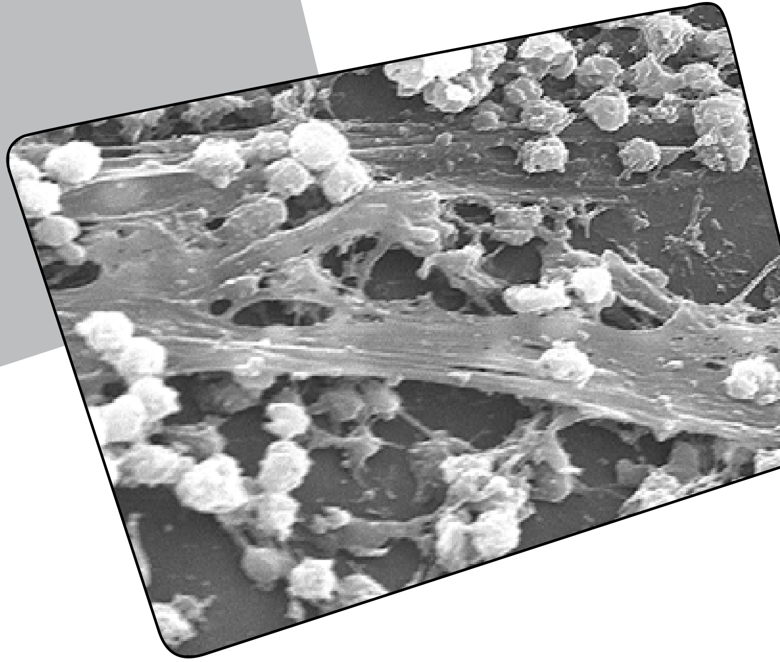
Reference

Chadhuri, Swades, and Derek Loveley. 2003. Bacterial batteries. *Nature Biotechnology* 21(10):1229–1232.

Battery

Bacteria



Biofilm ⇨ Bacteria Control

Bacteria are far from simple organisms. Some are able to organize themselves into large communities called *biofilms*. The bacteria residents communicate with each other by releasing chemicals.

On the microscopic level of bacteria, unseen chemical warfare goes on all around us. This cooperative activity of biofilms was first noticed on certain species of seaweed. In these underwater forests, friendly biofilms prevent the formation of foreign bacteria, which are harmful to the underwater plants. Studies have identified hundreds of chemical compounds, produced by biofilms, that affect their surroundings by "signal blocking."

One biofilm colony of special interest controls invading bacteria in animals. For example, cattle and dogs are susceptible to cholera infection, although they seldom become ill. The blocking biofilm prevents cholera bacteria from actively infecting the host animal. Our understanding of this benefit may permit the control of bacteria harmful to us by using "friendly" bacteria. Other specialized biofilms, when added to paint, prevent barnacles from attaching to boat surfaces. Further research

seeks to use biofilms to control corrosion in oil and gas pipelines. Such corrosion, often caused by bacterial growth, is a major problem in pipelines worldwide. Clearly, the potential medical and economic benefits of biofilms are enormous.

Internet search words:
biofilm, bacteria

Questions for further study

1. Estimate the number of bacteria on your hands.
2. Where might one find freshwater biofilms?
3. What are some unusual locations of biofilms?

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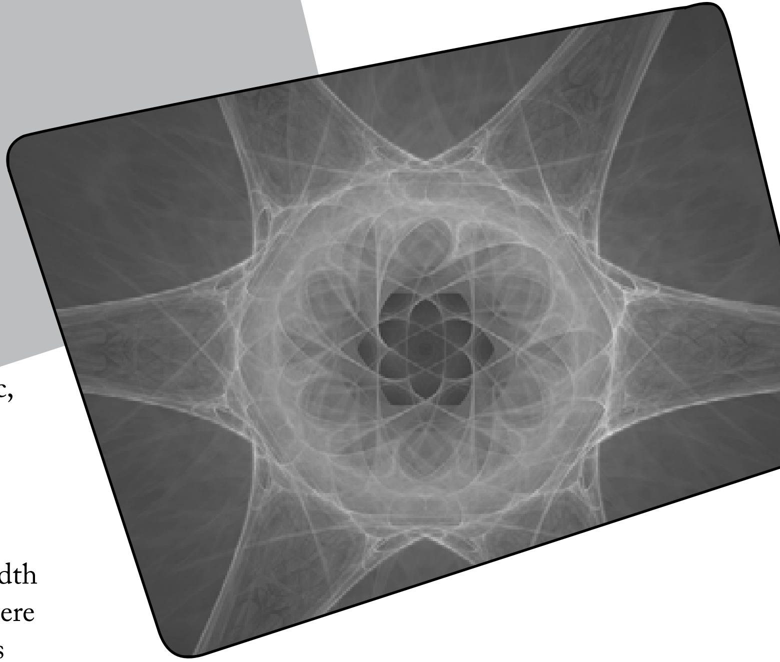
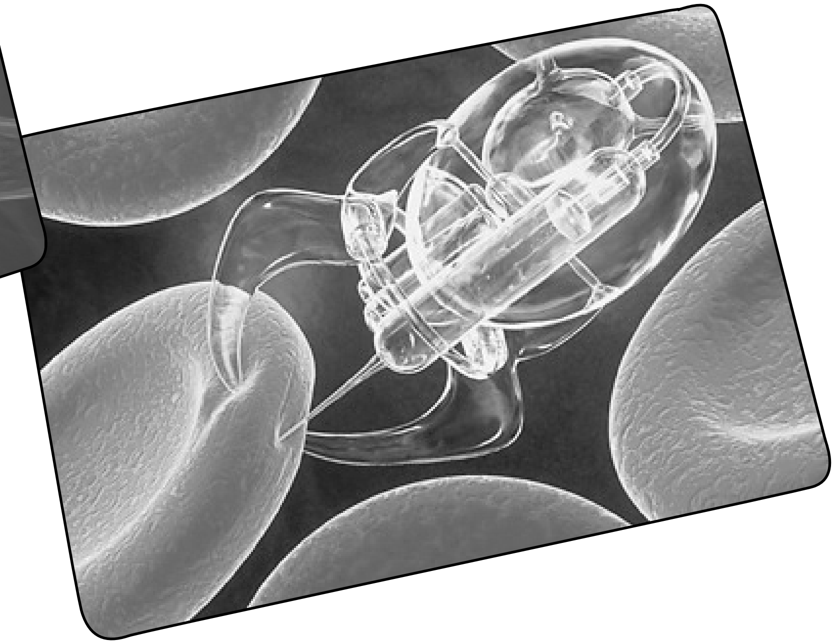


Diatom Nanotechnology

Diatoms are microscopic, single-celled algae. They are typically a few microns in diameter, ten times smaller than the width of a human hair. There are many thousands of distinct diatom species known, in both plant and animal varieties. They exist in countless numbers in the sea, freshwater lakes, and soil. They are the base of many food webs. Diatoms often house themselves inside intricate glass structures formed from silica or silicon dioxide, SiO_2. The intricate structures variously resemble stars, snowflakes, pyramids, chandeliers, cylinders, and crowns.

Scientists look to the diatoms for ready-made components in nanotechnology. One particular type of diatom resembles a circular glass gear, complete with an array of regular teeth around its outside edge. In the laboratory, this fragile structure is converted to a more durable form by heating at 900°C (1652°F) for several hours in the presence of magnesium gas vapor. The delicate silica glass vaporizes and is exactly replaced by the tough ceramic compound magnesium oxide with the chemical formula MgO. In an alternate process, diatom shapes can be converted to durable titanium oxide, TiO. Beyond the fabrication of microscopic mechanical gears, other diatom shapes are useful as tiny



lenses. Still others with multiple pore openings can function as micro filters. Researchers also hope to coax diatoms to grow into new useful shapes called "designer diatoms." The common diatom displays master craftsmanship and unlimited applications.

Questions for further study

1. Are diatoms plants or animals?
2. What is the mineral name for glass?
3. Diatomaceous earth is a powdered form of diatom fossils. What are some of its uses?

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References

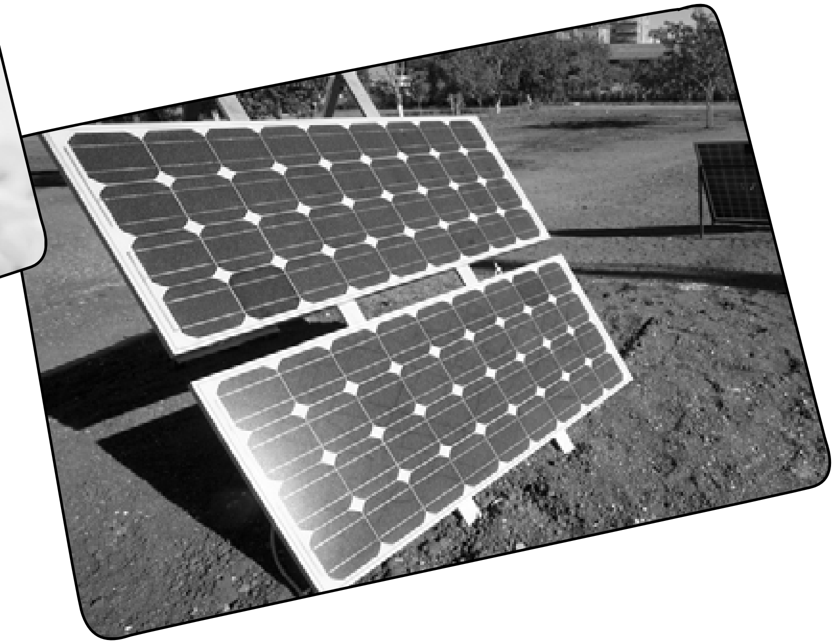
Cohen, Philip. 2004. Natural glass. *New Scientist* 181(2430):26–29.

Goho, Alexandra. 2004. Diatom menagerie. *Science News* 116(3):42–44.

Protein ⇨ Solar Cells

Plants are very efficient at capturing energy from the sun by photosynthesis. The silicon solar cells manufactured today are far less efficient and tend to degrade over time.

Researchers have succeeded in fabricating small solar cells using photosynthetic proteins. The proteins are taken from plants and then deposited onto a glass surface. Thin, transparent layers of electricity–conducting material are also applied. When light shines on the proteins, they cause a faint current of electricity to pass through the adjacent layers. By placing multiple layers in series, the plant proteins generate



a useful electric current. One advantage of the protein solar energy cell is its ability to repair itself when deterioration occurs, since plants are self-healing. Solar energy is largely an untapped energy source, and plant proteins show us one way to proceed.

Reference

Das, R. and many others. 2004. Integration of photosynthetic protein molecular complexes in solid-state electronic devices. *Nano Letters* 4(6): 1079–1083.

Questions for further study

1. How is electric current measured?
2. How is it possible that wind power, water power, and fossil fuels are all forms of solar energy?
3. Can you name three nonsolar forms of energy?

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