

TRIMTAB

Bulletin of the Buckminster Fuller Institute Vol. 14 No. 2 Spring 2001



working to advance humanity's option for success

Biomimicry

by Deborah Grace

'Biomimicry' has been a featured topic of discussion and the subject of presentations at a range of recent conferences including Industrial Ecology 2000, The Natural Step annual conference, Bioneers and EnvironDesign 5. This new methodology offers science, industry, municipalities, even individuals, a new way of accessing nature's intelligence and principles of design.

Janine Benyus, author of the book *Biomimicry: Innovation Inspired by Nature* (see book review page 5), and presenter at the above-mentioned conferences, provided us with a description of biomimicry and its significance to the way it can shape the future.

Biomimicry (from *bios*, meaning 'life,' and *mimesis*, meaning 'to imitate') is a design principle that seeks sustainable solutions to

"Nature is my mentor for business and design, a model for the way of life. Nature's system has worked for millions of years. Our culture has drifted away from learning from nature. The human way is to control the process, the product and the outcome. The natural way is a self-organizing feedback system. This system works. Biomimicry is a way of learning from nature."

David Oakley

Product Strategist, Interface, Inc.

human problems by consulting and emulating nature's time-tested patterns and strategies. The core idea is that nature, imaginative by necessity, has already solved many of the problems we are grappling with. Using nature's principles will allow us to create products, processes, and policies that are well-adapted to life on Earth over the long haul. Benyus challenges us to imagine harnessing energy like a leaf, growing food like a prairie, spinning fiber like a spider, growing ceramics like an oyster or running a business like a redwood forest.

Biomimics, of which Leonardo Da Vinci and Buckminster Fuller are excellent historical

examples, look to nature for specific advice: How will we grow our food? How will we harness energy? How will we make our materials? How will we keep ourselves healthy? How will we store what we learn? How will we conduct business without drawing on nature's capital?

With biological knowledge doubling every five years, we now have the instruments and the capacity to mimic nature like never before in history. "What would nature do here?" is the crucial question a designer asks to arrive at a biomimetic solution for any given problem. And success stories are already rolling in.

Living Machines

John Todd developed Living Machines® after he asked the question, "How does nature clean water?" The answer—by wetlands filtration—became the inspiration for waste water treatment systems that employ bioreactors with communities of organisms that use the waste input as nutrients, digesting them and in the process purifying the water. The water released from these systems is often cleaner than municipal tap water. (See *Trimtab* Autumn 2000).



Nature's Design

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Biomimicry (cont.)

Redesigned Signs

Any child can tell you that peacock feathers are brightly colored. What a surprise then to learn that the only pigment these feathers contain is the brown feather pigment melanin. The deep colors we see result from the directional layering of the feather's keratin protein which, combined with the melanin background, causes the light to refract in such a way as to have us see the color. The 'color' is structural.

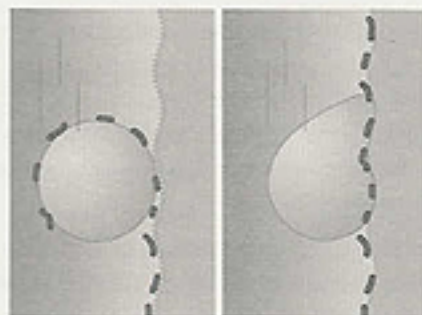
Inspired by this natural design, a Japanese company has created reusable display signs; the surfaces of these signs are structurally altered through exposure to UV light, which changes the crystalline alignment of the material, throwing off color to display a desired message. These signs can be continually reused and imprinted with new images, eliminating the need to manufacture new signs or use toxic paints.

Self-Cleaning Surfaces

While there is a growing trend to seek out benign detergents to reduce environmental impacts, there is a deeper biomimetic question to ask: "How does nature clean surfaces?" Indeed, when Prof. Dr. Wilhelm

Barthlott from the University in Bonn, Germany, posed this question and examined leaf surfaces for clues, it became apparent nature doesn't use detergents at all. Nature, instead, has a way of structuring surfaces with self-cleaning properties.

This insight has given rise to a novel type of building façade with a texture that has properties comparable to a lotus leaf: water droplets from rain will roll off the surface, automatically removing dirt as they wash over. A German company, ISPO, is manufacturing such a product, called *Lotusan*.



The lotus effect (left)

Carpet Colors

Interface, Inc., the carpet manufacturer that was among the first to adopt The Natural Step framework for creating ecologically and socially sound business practices (see *Trimtab* Autumn 2000), is also pioneering implementation of biomimetic design strategies that will complement its innovative practice of leasing, rather than selling, carpet tile.

A significant amount of waste is generated in the manufacture of carpet, often due to slight color differences from batch to batch that also make the replacement of worn carpet tiles more difficult. Designers at Interface have explored natural models for design and color to find answers to design questions. These explorations have resulted in "Entropy," a carpet that mimics the random color palette of a grassland and a forest floor, resulting in easier matching of replacement tiles, fewer discards,

easier installation, all ultimately resulting in waste reduction.

Sustainable Agriculture

Among the most meaningful lessons of biomimicry is its application to agriculture, where it has the potential to impact

our lives at the core. Modern agricultural practice has imposed demands on plants and soil that are not in harmony with the natural needs of the system. From plowing each year in order to plant annual crops, to chemical fertilizers and oil-based pesticides, it takes about 10 kilocalories of petroleum to produce one kilocalorie of food.

Natural systems agriculture looks at a landscape and asks, "What grows here naturally?" The way to get off this 'treadmill of vigilance,' says Wes Jackson of the Land Institute, is to breed edible perennial crops and

"The extent to which the natural world can provide technological solutions for the types of product performance characteristics we must provide are virtually unlimited. Biomimicry still requires exploration, innovation and creativity, but by thinking like or working with a biologist we must learn to ask a different set of questions and look to nature for inspiration and learning opportunities."

Darcy Winslow

GM of Environmental Business Opportunities, Nike Inc.

grow them in a prairie-like polyculture. What we would have, instead of an extractive agriculture that mimics industry, is a self-renewing agriculture that mimics nature. Wes Jackson was recently awarded a Right Livelihood Award, commonly known as the 'Alternative Nobel Prize,' for his two decades of work to develop a sustainable agricultural system based on perennial prairie plants.

High profile companies such as Interface, Inc. and Nike have recognized the innovative potential of biomimicry. Both have been participating in two-day workshops that Dayna Baumeister, a colleague of Benyus, offers to introduce biomimicry. Suitcases full of zoological specimens offer visual prompts for ideas: branches from a cholla cactus, specimens of wood, antlers, coral, spiders, fur, shells, lightning bugs, leaves, feathers, etc... Participants have the hands-on experience of looking to nature for design ideas and leave the workshops understanding the value of collaborating with biology and biologists on design projects, whether for transportation systems, a new product designs, or new company structures.

Resources

Biomimicry: Innovation Inspired by Nature, by Janine Benyus (see book review page 5)

The Biomimicry Project: www.biomimicry.net

Lotus-effect: www.botanik.uni-bonn.de/system/bionics.htm

ISPO and Lotusan: www.ispo-online.de/islotus.htm

The Land Institute: www.landinstitute.org

Interface's Entropy: www.interfaceinc.com/us/feature/entropy

Images

Rosette photo courtesy of Werner Krutrin.

Lotus effect diagram courtesy of ISPO GmbH.

Nature as Model Biomimicry is a new science that studies nature's models and then imitates or takes inspiration from these designs and processes to solve human problems, e.g., a solar cell inspired by a leaf.

Nature as Measure Biomimicry uses an ecological standard to judge the 'rightness' of our innovations. After 3.8 billion years of evolution, nature has learned: What works. What is appropriate. What lasts.

Nature as Mentor Biomimicry is a new way of viewing and valuing nature. It introduces an era based not on what we can **extract** from the natural world, but on what we can **learn** from it.

Janine Benyus 1997, *Biomimicry*