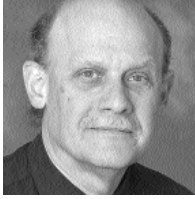

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Steve Belletire teaches industrial design at Southern Illinois University, Carbondale. His research into sustainable design led to his becoming one of three co-authors of Okala, an undergraduate ecodesign course now in use by many design education programs throughout North America.

A Sustainable Future, Naturally

BIOMIMICRY

Overnight—in earth-age terms—we have learned to extract, process and fashion available resources into an endless variety of artifacts, foods and habitats. This "industrial revolution" has resulted in dramatic increases in population growth, longevity of life and living standards. These have been accelerated by the more recent technology revolution, which has also helped to spawn a global consumer economy.

Above: The Bronze 2005 IDEA winner SoleMates concept by Design Directions of India is an example of positive environmental design.

Nature inspired Velcro®.

Through both of these changes, we have consumed vast quantities of non-renewable resources and created prodigious amounts of toxic waste. Future historians will likely characterize this as a time when our hubris obscured our understanding of the earth's natural processes to maintain the balance of life.

In the midst of these changes, industrial design emerged. Initially a partner of mass production, the profession matured to become an ally of business. But today, technology and globalization are forcing traditional design services into the role of a low-cost provider. In response, some designers have embraced value-added approaches that emphasize branding, innovation and strategic partnering with other professionals. However, I believe many business strategies will ultimately fail if we continue to deplete the earth's resources and pollute our living spaces.

Biomimicry, a trend in science that studies natural phenomenon and transfers what is learned to human needs, offers the potential to reverse these trends. **Biomimicry offers countless models for creating a sustainable future, provided that we are willing to reconnect to the innovation that exists in our natural world. Biomimicry embodies the concept of sustainability and holds great promise for the future of our earth, its species and industrial design.**

Studying the processes of successful life forms reveals that our living earth has evolved into the consummate innovator. All around us are species and ecosystems that use the sun's energy and the earth's resources to adapt, propagate, grow, renew and eliminate waste in harmony with others while sustaining healthy environments. Nature's approach is in stark contrast to our current human model of extracting, processing, consuming, disposing of and polluting our resources.

Biomimicry in Action

We all have experienced biomimetic products like Velcro®, but these are but a glimpse of the many ways biomimicry is helping to reshape our life on earth. Researchers are looking to nature to address some of our most vexing needs. Biologists, biochemists and others are forging a sustainable future that contains new ways to harvest energy, grow foods, create medicines, manufacture products and design businesses.

As our energy needs rapidly expand, photosynthesis may hold the ultimate solution. We already have developed silicon photovoltaic cells, but they are still large and costly. However, Tom Moore and Ana Moore, biochemists at Arizona State University, have built a synthetic molecule that may lead to tiny natural molecular batteries that can be painted onto any surface to harvest the sun's energy. In Canada, researcher James Gullet is using the pond duckweed plant as a model for a new chemistry. This solar-driven chemistry employs a pool of reusable polyethylene beads that may be able to create a wide variety of naturally made chemicals, eliminating the current need to use fossil fuels.

Some physicians looking to reduce the overuse of antibiotics believe that maggots (yes, maggots!) may offer an effective way to treat wounds infected by the super bug *methicillin-resistant Staphylococcus aureus*. New research shows that maggots, as practiced for decades before the advent of modern antibiotics, are an efficient and safe method for cleaning infected wounds. Similarly, researcher Bryan Fry has identified that the active ingredients in snake venom are chemical proteins needed for the snake's organs to function. Over the last 80 million years, snakes have been able to convert these proteins into toxins to paralyze predators and prey. Fry's research holds the promise of new nature-derived pharmaceuticals that can treat everything from liver disease to brain disorders.

Throughout the world, many small experiments are underway that challenge our chemically dependent crop methods. Using native plants as their model, scientists from The Land Institute, have developed ways to grow a polyculture of perennial grains that offer yields that approach those of annual crops while vastly reducing the chemicals in soils and plants and the energy inputs needed in traditional agriculture.

In contrast to the low-impact, low-energy material capabilities of nature, material manufacturing requires a huge expenditure of energy. Biochemists are uncovering nature's methods for manufacturing crystals, the structure behind natural materials like the rigid but highly flexible abalone shell. Scientists are building on this knowledge to explore non-toxic, low-energy methods for naturally growing crystals that could result in lightweight, durable coatings for windshields, drive gears and optical devices. Another ocean creature, the blue mussel, attaches itself to underwater structures by applying a waterproof adhesive with remarkable holding properties. This enigmatic creature is teaching researchers how to develop a new generation of environmentally benign, high-performance adhesives and composite materials.

The human brain contains one hundred billion neurons wired together in one massive computing network. The success of our parallel computing stems from carbon compounds that can take on a million different shapes. In nature shape is synonymous with function, and proteins are best at pattern and shape recognition. These biological models are the basis for experimentation in new computing platforms using molecules as processors and

DNA as storage media. Such devices could conceivably execute more than a thousand trillion operations per second. Science fiction? Our brains do this continuously.

Closed-loop manufacturing based on the regenerative capabilities of a mature forest ecosystem is becoming a viable business model. The idea is for manufacturing plants to mimic forests by running on sunlight and reusing their waste. In an experiment at an industrial ecopark in Kalundborg, Denmark, several large manufacturers are mimicking a natural food chain, exchanging waste materials that are useful to one another. The result is lower energy costs, less waste, increased productivity and less impact on the environment.

Prospering from Biomimicry

If biomimicry represents a path for a sustainable future, how can designers participate and benefit from what biomimicry has to offer?

First, we need to become versed in life-cycle planning that considers each step in the product design process, starting with the extraction of raw materials and ending with renewal or reuse of the manufactured product. We also must learn to identify the materials and energy needed to sustain each phase of a product's life cycle and to understand the inherent environmental impacts. With this foundation, we can use analysis skills to identify needs and apply our creative capabilities to generate innovative business opportunities. This process embodies a strategic approach that enables designers to help conserve resources, protect environments, meet human needs and generate economic value.

While a sustainable design world may seem to be off into our future, many businesses are placing biomimicry-based design on their short-term agendas. Companies that value design—Nike, Herman Miller, Steelcase and the like—have publicly committed to embracing the principles of sustainability and are designing new processes and products that reflect these principles. US-based McDonough Braungart Design Chemistry, a consultant group, is helping to effect change through new cradle-to-cradle, biomimicry-based design protocols that reflect the global shift toward sustainable business practices.

The global trend toward sustainable design is also apparent within our professional society. The 2005 IDSA IDEA competition applied expanded ecodesign criteria to this year's worldwide entrants. The jury selected several winners whose designs demonstrate positive environmental qualities. Two footwear designs of note were the Gold-winning Nike Considered Boot and the Bronze-winning SoleMates concept by Design Directions of India.

Europe and other parts of the world are helping to drive global sustainability through legislation that mandates specific product and packaging "take-back" by the manufacturer. This new reality has design teams rethinking the life cycles of even our most basic products. In short, the worldview of our current model of extracting, processing, consuming, disposing and polluting is beginning to shift toward a more sustainable approach. Biomimicry is one path that responsible businesses can choose to help shape positive, sustainable change.

So, what is the responsibility of designers to the future? Should we design products that will be appreciated more for their great design or for their sustainability? By combining the tenants of biomimicry, life-cycle planning and design excellence, we can achieve both. ■