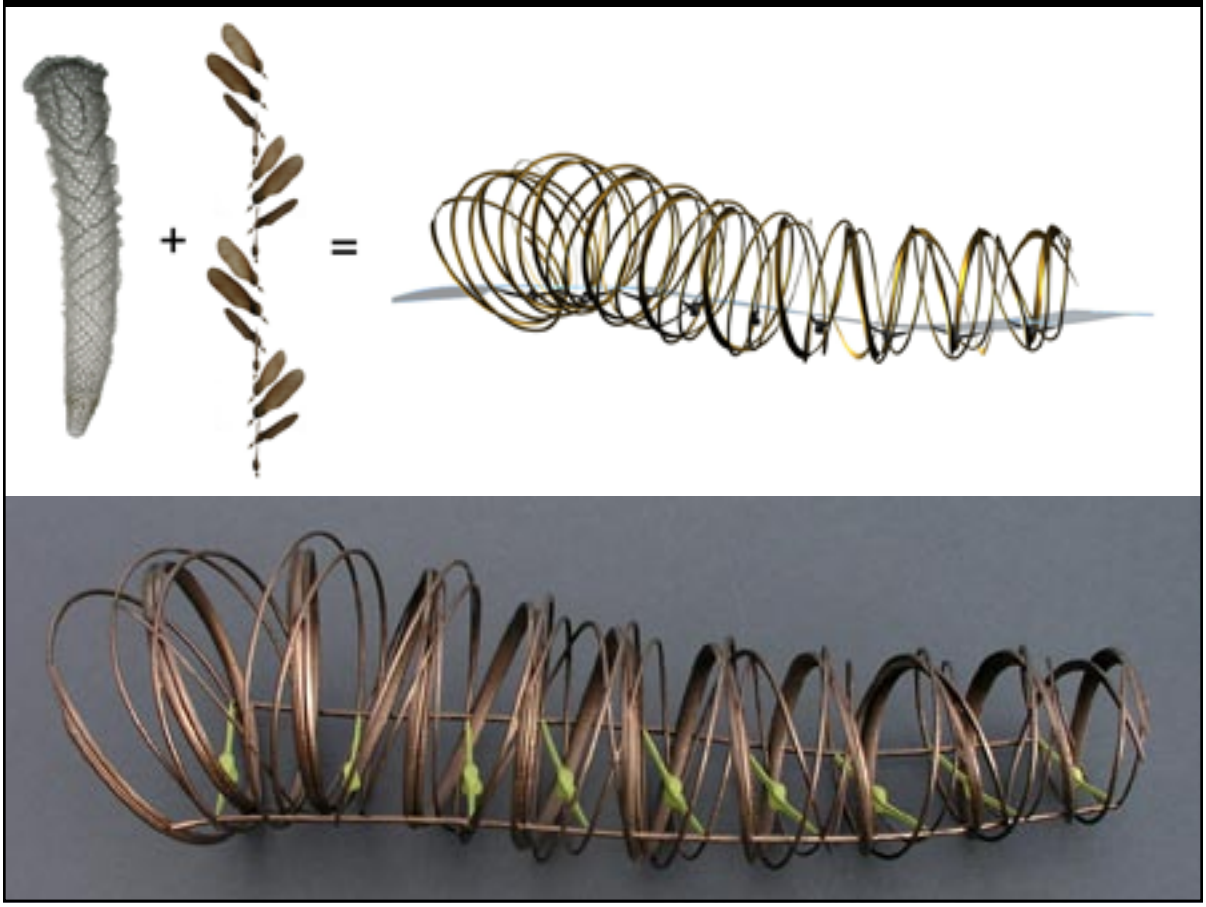
Design Biomimetics:
An Inquiry and Proposal for Architecture and Industrial Design

Dennis Dollens



Spiral Bridge based on the sponge *Euplectella* and the leaves of *Tipiana tipu*. 2004-ongoing. Dennis Dollens and Ignasi Pérez Arnal.

A report to the
Genetic Architectures Program
Alberto T. Estévez, Director
and to the
Department of Ecology and Architecture
Ignasi Pérez Arnal, Director

Escola Tècnica Superior d'Arquitectura
Universitat Internacional de Catalunya. Barcelona, Spain
September 2005

email: exodesic@mac.com
A PDF version of this paper is available at www.tumbletruss.com

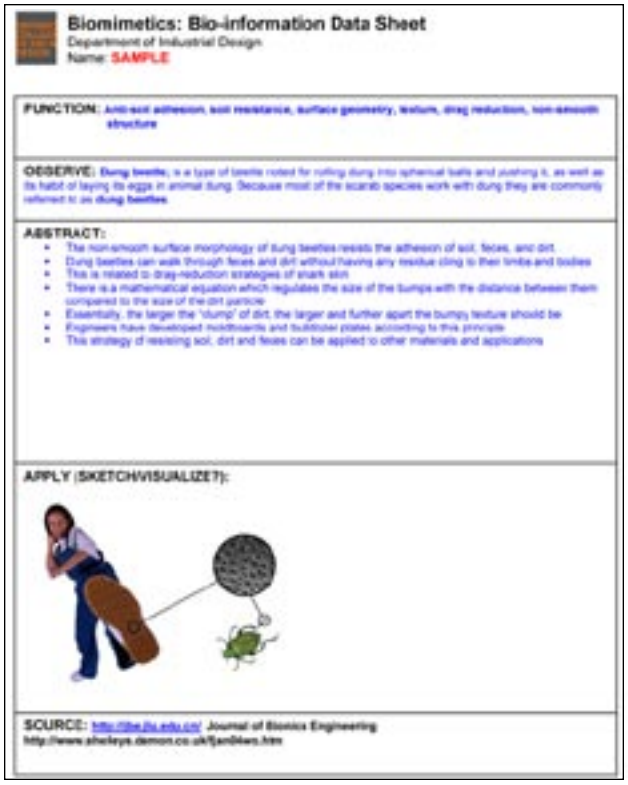


Figure 7. BID sheet developed for OCAD by Nima Motamedi for a digital template based on Sue Redding's prototype.

2.3 Clemson University

Within a context of digital design, the word "animated" brings to mind animation or anima and only secondarily the context of mind/soul and life force. So the year-long, thesis option, headed by Keith Evan Green, associate professor of architecture at Clemson University in South Carolina, comes as a surprise when you understand that Green is talking about environmental life, life systems, and biological life within the matrix of urban and suburban sprawl. Green has set an agenda of mapping anima from within and without ecosystems, with a broad enough reading of "ecosystems" to include arteries such as highways, and cancers, such as strip development, right there next to healthy organs, such as waterways, farms, and parkland. And that reading is guided by analytic readings of David Orr's *Ecological Literacy* and Benyus's *Biomimicry*, on the basis of which Green states: "Animated Architecture Studio asks students to conceive the things they design as *living* things." In my experience, outside of the university, just introducing architecture as a live or potentially live organism closes many normally open minds faster than a speeding bullet.

If Green's studio experiment in architectural thinking, analyzing, and extrapolating design from nature demonstrates the need for other university design laboratories to follow

Clemson's lead, his studio also sets a model worthy of study for its determination to integrate organisms and scales—macro to micro to urban—with the underlying acknowledgement of biological connectedness between the animate and inanimate. Some of the studio topics may, at first, seem unlikely sources for biomimetic architectural inspiration, but Green's students discover natural models, such as corals or other organisms for integrating their research findings with landscapes.

Billy Zion's work in Green's studio (Fig. 8), a proposal for a mobile/stable architecture that appropriates some of the behavior of slime mold, holds particular interest since modeling from the organization of slime molds gave the project a range of unusual possibilities arising out of the study of a microorganism. Defined by the Biotech Dictionary slime mold is "A nonphototropic eukaryotic microorganism lacking cell walls, which aggregates to form fruiting structures (cellular slime molds) or simply masses of protoplasm (acellular slime molds)." Slime mold behaves, under specific circumstances, as an individual organism but

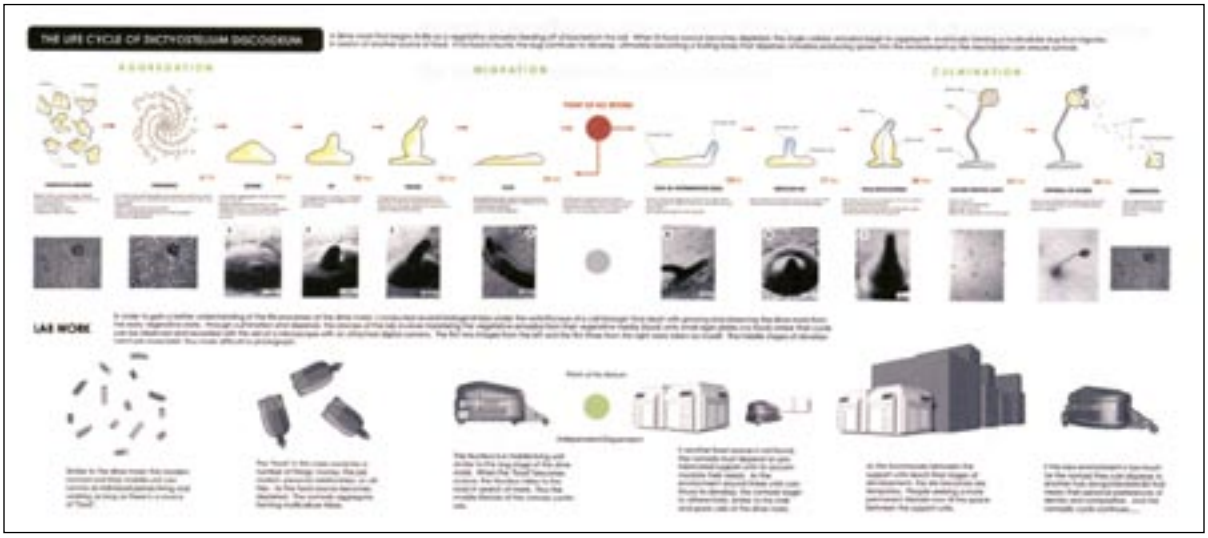


Figure 8. Billy's Zion's evolution of slime mold into a mobile architecture from Keith Green's Animated Architecture Studio.

when necessary migrates to join other individual slime molds in becoming more complex, aggregate life systems, capable of greater mobility—a kind of ground-based swarming phenomenon. The molds join together in order to propagate as well as to search out larger food sources; once those goals are accomplished, the complex organism may revert to individuals or dissipate as spores.

Zion reconceptualized the biomimetic extrapolations he dealt with as part of a design program for producing mobile habitation units. This program included social and physical

considerations, with the units having changeable functions—sleeping, cooking, etc.—while also having the capability of being organized three-dimensionally in temporary clusters. In this project, biomimetically researched (as opposed to observed) attributes and properties have been derived from scientific literature that focused on microorganism's operational and survival tactics that could be used as a design-thinking tool in order to deal with a design project and the way that project fits into the environment.

One of the most interesting aspects of Green's approach to biomimetics is that it encompasses a very large physical area and thus looks to natural systems as inspiration and overlay for existing urban/suburban conditions while still maintaining a view to biomimetic relationships relevant to smaller-scale design. His studio, in effect, shows the potential for an integrated way of studying nature across scales where architecture, urban planning, and environmental planning become interleaved sets of reliance requiring design solutions.

2.4 Art Center College of Design

In an unexpected example of a biomimetic class, I learned of AnnMarie Polsenberg's "Nature's Design," given through the Liberal Arts and Sciences Facility (not the design facility) at Art Center College of Design in Los Angeles. This class is open to first-year through graduate-level students and is entering its fourth session. Polsenberg is a PhD candidate in mechanical engineering at Caltech who did undergraduate work in ocean engineering at MIT. She is interested in robotics and for the first three iterations of the class she assigned Steven Vogel's *Cat's Paws* as a required text with almost weekly reading assignments coupled to written analyses of the text. A class without design assignments yet aimed at designers and artists and focused through reading, visualization of natural objects, and written analysis provides a biomimetic foundation for design thinking.

"Nature's Design" is filtered through an engineer's perspective, so lecture topics such as "Evolution vs. Design," "The Importance of Size," "How Does Nature Achieve Strength?" "Muscle: Nature's Engines," "Pulling vs. Pushing," "Energy: What Lessons Can We Learn from Nature?" and "Sustainability: Why Doesn't Nature Need a Waste Basket?" resonate differently than they would if discussed by an architect or industrial designer. This difference is an important point when you realized that robotics are an element in Polsenberg's specialized field: even if they occupy only one of the three-hour classes, they nevertheless inform the thinking and methodology behind the conception of the class. The study of natural systems biomimetically analyzed, with robotics or automated systems and engineering even as background presence, helps create an environment in which hybridized