BioInspired!

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Center for Biologically Inspired Design

Engaging the BID Community

We are a community of active or aspiring practitioners with a shared goal of making bio-inspired design a valuable and valued design strategy. We benefit from the expertise of organizations such as the Center for Biologically Inspired Design at Georgia Tech as well as the experience of members on what works and what still needs to be done. In addition to delivering information to the community, we need to actively encourage interaction and collaboration within the community.

A number of members identified specific services that would make the community valuable to them. The ideas fall into three main categories:

- information: resources, case studies, methods, a patent and products watch, notification of meetings and workshops
- networking: making contacts, discussing tough questions, identifying tools, getting feedback, awareness of what others are doing
- opportunities: funding sources, research and discoveries that could be commercialized

Some members have pointed out that the Internet already delivers a tremendous amount of material about biomimicry and bio-inspiration. Yet "Information these days is a commodity; understanding is scarce." (*TIME*, 2010, *176*(23), p4) How reliable and useful is the data? Can principles be easily extracted? What are the potential constraints that restrict where these principles can be applied? A colleague pointed out that while acquisition costs are dropping dramatically, the processing and analysis effort may actually be increasing.

Distilling data into information, positioning it in the larger context and demonstrating relevance can significantly increase value. As an example, the first article in this issue provides insights into the HOK/Biomimicry Guild partnership and explores the practice of applying biomimicry to the built environment.

Kathleen Murphy looked for help from the community to design a biomimetic carry-on bag: her journey to find biological principles that would help achieve her product vision is described in the second article. This is followed by Kathryn Nagel's research on the role of evolution in the bombardier beetle's unique defense mechanism. Marc Weissburg's commentary explores the differences between unintentional (evolution) and intentional (human) design, leading to more effective strategies for searching biological literature.

In the next article, Ashok Goel continues his exploration of the cognitive aspects of bio-inspired design, including how to think and communicate across disciplines. The final article summarizes the community's first networking event: the October 21st 'Forest Fractal' Skype conference call hosted by Faye Yoshihara on the potential for developing better business and organizational models through biomimicry.

Anyone registered on the website will have full member access until the membership process is in place. The current plan is to implement an automatic quarterly payment system through PayPal in January 2011 to help fund community services and future projects. Watch for an announcement through the website.

Inside This Issue:

Enjoy the rest of the newsletter and check out the **Call to Action** on the back page for ways to get involved. Please let us know what you think, either through comments on the website or using the Contact Us link at the bottom of each website page.

The *BioInspired!* newsletter publishes material from a wide range of sources. The opinions expressed in articles are entirely those of the authors and do not necessarily represent the views of the Center for Biologically Inspired Design.

Perspectives on the HOK/Biomimicry Guild Partnership *(Mary Ann Lazarus)*

HOK is the largest architecture-engineering firm in the U.S. and the fourth-largest worldwide with over 1,800 professionals in 25 offices across three continents. HOK and the Biomimicry Guild announced a formal alliance in September 2008 that has added depth and breadth to HOK's offerings through access to the expertise of dedicated Guild staff. In turn, the Biomimicry Guild has been able to influence large scale projects and demonstrate the value of applying biomimicry to the built environment.

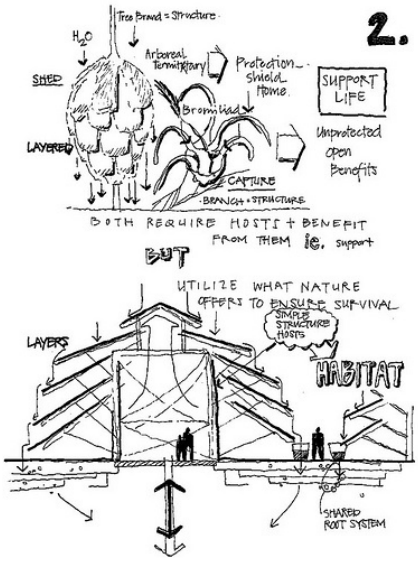
HOK is a long-standing leader in innovation and sustainable design since its founding 55 years ago in St. Louis, Missouri by George Hellmuth, Gyo Obata and George Kassabaum. It was an early adopter of computer-aided drawing and the Building Information Modeling (BIM) approach to support integrated design. *The HOK Guidebook to Sustainable Design* (2000, updated 2005) reflects not only HOK's commitment to sustainable, high performance design but also its willingness to share the knowledge and expertise it has gained over the last 20 years. Hellmuth's 1944 vision of a recession-proof architectural office incorporated principles of resilience before the term became fashionable, including building for the long term and incorporating diversity at all levels.

I first met Janine Benyus and Paul Hawken at a retreat for HOK leadership organized by Ray Anderson. Over the next two years, nearly 250 leaders at HOK were introduced to biomimicry and its importance in achieving a sustainable built environment. Janine and I saw an opportunity for a more targeted initiative that would allow HOK to integrate the Biomimicry Guild into specific projects. In turn, the alliance supported the Biomimicry Guild's shift from broadly spreading its message (r-strategy) to a more selective relationship with key partners (K-strategy).

To date, HOK and the Biomimicry Guild have collaborated on a number of significant large-scale design projects in India, China, the Middle East and South America. The most fruitful opportunities have been projects initiated by visionary leaders who have an appreciation for nature, desire leading-edge designs and have the patience for truly innovative designs to evolve.

HOK is responsible for the Master Plan for the Lavasa Hill Station project, a 15000 acre site near Pune, India. The first of three villages, Dasve (pictured on the left), is currently under construction. The entire project is expected to be completed by 2021. The goal is to create a robust micro-economy while at the same time preserving and regenerating the local ecology. For example, sensitive areas are protected from development while over a million saplings have been planted to regenerate 'slash and burn' sites .

The environment is one of extremes where the importance of 'place' and context is self-evident. The area is a linear valley with steep slopes that experience three months of monsoon followed by drought. Water is a key factor shaping the local ecology and is both protected and celebrated in the Master Plan. The Biomimicry Guild team (shown doing a site walk in the image on the right) was able to provide insights on how local species not only survive but thrive.



Traditional construction concentrates water through impermeable surfaces, exposes the soil and disturbs its root structure. In contrast, the forest canopy, understory, detritus and root networks of the native ecology dissipate the energy of monsoon rains and hold moisture for the dry season. Designers have used this information to create a wide range of site-specific innovations from design facades to construction methods and regeneration techniques.

In addition to inspiration, good designs benefit from the rigor provided by quantitative measures. HOK and the Biomimicry Guild are using Ecological Performance Standards as a way of assigning metrics to the ecosystem services provided in a specific setting, such as water management, carbon sequestration and increasing biodiversity. These metrics become inputs to the design process with the goal of creating built environments that match or even enhance the functioning of healthy ecosystems. Assigning values to ecosystem services is not new and can be a powerful force for conservation. The Ecological Performance Standards go further by applying a holistic and site-specific perspective that challenges and inspires designers to come up with equally effective solutions.

Perspectives on the HOK/Biomimicry Guild Partnership *(continued)*

Both HOK and the Biomimicry Guild have learned much about the practice of applying biomimicry to the built environment, from dealing with insane schedules and deadlines to including biologists at the design table as well as the challenges of turning inspiration into reality. If designs are to be built, they must be grounded in the 'here and now' of budgets, timelines and available technologies.

Now is a great time to be a designer. The design industry is undergoing a revolution, driven by concerns about the environment and growing economic constraints. There is a renewed interest in creating healthy environments both inside and outside buildings. Emphasis is shifting beyond aesthetics to design grounded in fundamental principles, drawing on biology, ecology, vernacular architecture and a deep understanding of "place". The industry needs to attract designers who bring expertise in modelling, systems thinking and lifecycle analysis, as well as fresh ideas that challenge assumptions. Beyond the tangible benefits, biomimicry opens new horizons to designers and sparks a new passion for their work.

Suggested Readings

- the future of GREEN – interview with Mary Ann Lazarus on sustainable design practice and biomimicry at HOK
- Inside the Designer's Studio 28: Mary Ann Lazarus, HOK Sustainable Design Director – four video clips on why now is a great time to be a designer: drive change that benefits business and helps us live more sustainably
- The Darwinism of architecture - how Biomimicry will evolve architecture – Lavasa project and Ecological Performance Standards
- India's first new hill station, *The Big Project*, issue 8, pp14-26 (referenced in Lavasa Project Featured in 10-Page Cover Story)
- In India, the Ripple Effect of a Single Drop of Water - audio clip of Dhaval Barbhaya describing how water can inspire design
- Architecture That Imitates Life – Harvard Magazine article by Thomas Knittel of HOK on designing *with* Nature
- r and K selection – overview of r- and K-strategies to different environmental conditions

Mary Ann Lazarus is an architect in HOK's St. Louis office and is the firm-wide Sustainable Design Director.

The Hunt for a Bio-Inspired Designer *(Kathleen Murphy)*

I have a passion - unencumbered travel with the perfect carry-on bag at my side. I want it all - all my favorite thing (yes, even heavy running shoes) in one small, beautiful bag that gently sits, more melds, to my shoulder. For more than a decade, I have searched, shopped and bought not-quite-the-right one. This summer, I finally faced the truth - the bag did not exist. It was time to take the leap and enter the product design world with my big ideas and no experience.

I wanted every design element to serve its natural purpose; no aesthetic add-ons that take up space. I wanted the look to mimic the exquisite beauty of nature; not replicated images but an exterior and interior of resilient, intricate texture in a clean, purposeful structure.

I talked to fashion designers, product designers, inventors, and material consultants. Something was not right. Something was missing in the process they presented. I knew about The Biomimicry Institute through my development work in environmental education. I finally read Janine Benyus. Of course. Of course. This is it. I had to start over.

My primary goal is to design a strap and a structure that is in perfect balance with the body - ease, grace, intelligence. I want to reconsider the shape of standard carry-on luggage. Does my favorite bag - my grandmother's cosmetology bag from the era of Art Deco - have the right dimensions naturally? Why are most handbags just an empty, endless hole? How does nature handle depth? Compression? Expansion? How does nature retrieve things and carry heavy cargo?

The Hunt for a Bio-Inspired Designer *(continued)*

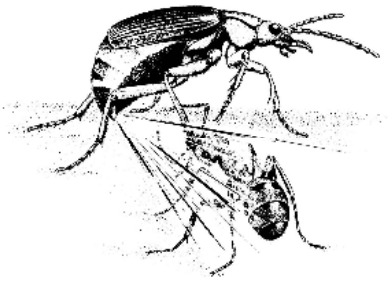
At this time, the prototype design is on hold. Intuitively, I want to mimic nature but lack the necessary background information. I am immersed in the questions (thanks to Norbert). I am going through the Design Spiral and AskNature.org at night - no easy task for a want-it-now, want-it-all person. Clearly, nature is teaching me more than product design. I hope to take Tom McKeag's class at the California College of the Arts and am collaborating with one of his students on a possible design. I plan to apply the theories and start to sketch from scratch what my grandmother carried to school and work: all the tools for beauty, but adding perfect weight distribution and space capacity.

I will continue to watch what happens in nature every day. I know I will find the answer. Onward I go thanks to all of you who are committed and practicing what is intelligently and beautifully obvious.

Kathleen Murphy is a development associate in Oakland, California. Family, clients, travel, nature, and all that is visual and written inspire her.

The Evolutionary Basis for the Chemical Defense of Bombardier Beetles *(Kathryn Nagel, Marc Weissburg)*

Complex biological designs are often used by proponents of intelligent design as evidence to refute evolution. In their view, the idea that organisms perform functions necessary for their survival (i.e., are "designed" for certain tasks) is taken as evidence for the existence of a designer. Those who do not accept the scientific validity of evolution appear to be fixated on the use of the word "design", which in their view must represent an intentional process. As is clear from hundreds of years of study across many fields, evolution is a design process that is sufficient to account for biological characteristics without requiring a guiding intelligence.



Bombardier beetles have a highly sophisticated chemical defense system that emits a heated fluid at high pressure and has been used as an inspiration for manufacturing technology (see **Swedish Biomimetics 3000®** article in the February 2008 newsletter). Although proponents of intelligent design argue that the complex and specific anatomical structures and chemical secretions provide proof of intentional design, the scientific evidence relating to the chemistry of the spray, the evolutionary history of anatomical characteristics and the *limitations* of the defense system reveals a clear evolutionary process.

When disturbed, some bombardier beetle species can emit rapid pulses of superheated chemical spray from their abdomen that can be accurately aimed in any direction, effectively deterring both vertebrate and invertebrate predators. Proponents of intelligent design argue that all of the components of this system must evolve simultaneously - piecemeal evolution through a series of stages results in animal properties that would not be adaptive and may even be harmful. They argue that without the elaborate structures to control and direct the spray, the chemical reaction would cause the beetle's abdomen to explode. However, thermodynamic analysis of the reaction confirms that the chemical components do not cause an explosive reaction, but rather it is the high pressure maintained in the outer chamber that results in high temperatures. The release of the hot fluid is the result of a pressure build-up (much like the valves in mammalian hearts) and occurs before the internal pressure reaches levels dangerous to the beetle.

Studies across bombardier beetle species show a clear pathway whereby the sophisticated spray defense mechanism evolved in stages, each of which is useful in its own right and therefore provides an evolutionary advantage. Bombardier beetles comprise two different evolutionary branches within the family Carabidae. Species in the primitive (paussoid) branch do not have an advanced spray mechanism but instead use grooves on the sides of the abdomen to direct their chemical defenses in the general direction of predators. The most primitive bombardier species *M. contractus* has rudimentary glands with two chambers that secrete quinones in a bubbling froth rather than a directed spray. This demonstrates that the advanced mechanism of a directed spray has evolved in incremental stages, each providing evolutionary benefit.

The intelligent design argument that novel complex structures

The Evolutionary Basis … *(continued)*

The intelligent design argument that novel complex structures cannot evolve in stages also questions how the evolutionary process could account for the specific chemical components involved in the defensive spray. This argument ignores the widespread use of these chemicals in other life-processes. In fact, evolutionary steps from the basic storage of quinones to the intense jet-like pulses can be identified. Quinones are produced by many different insects and the most primitive use of them is storage in the skin, since quinones are quite foul tasting. Related insects have evolved structures to house and store these chemicals. Since chemical defenses evolved in the Carabidae family as early as 100 million years ago, these insects have had a long time to evolve from primitive storage and secretion mechanisms to complex sprays of superheated quinones, from the abdominal grooves in primitive families to the complex spray-aiming tip in the advanced beetles. Phylogenetic data supports the evolutionary lineage and the increase in complexity of the spray mechanism over time.

The final argument for the preeminence of evolution in the production the spray-defense mechanism of the bombardier beetle relates to predator-prey interactions. Bombardier beetles are able to successfully avoid predation by many different types of predators. However, even the elaborate spray-defense mechanism is not designed so perfectly that it deters all predators. One species of orb weaving spider, *Argiope*, is able to capture the bombardier beetle using a patient and careful strategy. When first caught in the web, *Argiope* advances towards the beetle and throws silk around it without attempting to seize the beetle, eventually covering the beetle with silk and hampering its chemical spray. Certain bird species may also be able to avoid the harsh chemical defense of the bombardier. In other words, predation is still a driving force and the unconscious evolutionary process still continues to influence this system as environmental conditions change.

The three-pronged examination of the chemical basis of defense, the progression of defensive structures within the beetle's evolutionary lineage and the driving forces behind bombardier beetle evolution reveals many distinctive aspects of this beetle and its interaction with other species. By focusing on the final form, supporters of intelligent design often overlook and rarely consider the rich history of the bombardier beetle's defense system. While more study of bombardier beetles is required, established literature supports the evolutionary explanation for the defense mechanism of these complex and extraordinary insects.

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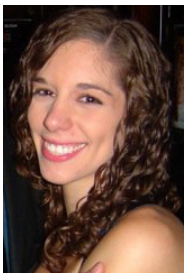
- Skelhorn, John and Ruxton, Graeme. Ecological factors influencing the evolution of insects' chemical defenses. *Behavioral Ecology* (2007).



Kathryn Nagel is a lab technician and researcher in the School of Biology at Georgia Tech. She primarily studies the affect of harmful algal blooms on copepod behavior and chemical signaling.

The Evolutionary Basis … *(continued)*

Implications of Evolution to the BID Process

Designers who wish to utilize BID effectively must be cognizant of evolution. As the accompanying piece by Kathryn Nagel makes clear, the design process responsible for properties of biological systems (i.e., evolution) is rather different from the (hopefully!) intentional process of a human designer. Although we often use the terms *biological solutions*, we are nonetheless referring a set of properties that achieve a given function as a result of evolution, not deliberate design.

In addition to lacking conscious intent, the evolutionary design process capitalizes on preexisting structures or properties, sometimes creating new functions that are wholly unrelated to previous usage. The evolutionary process has been likened to tinkering; many unsuccessful modifications are created, and the most successful new variants go forward. These changes occur within a group of organisms that are related by descent, and new properties are the result of modifications to earlier characteristics. The ways in which biological systems achieve functions therefore are strongly constrained by history. Although serious students of design may recognize that some of these problems plague our design process as well, we can choose to avoid these constraints. Such options may challenge us, but are virtually impossible for the evolutionary design process.

Teaching BID to many different groups has lead us to conclude that a basic understanding of the evolutionary process leads to more effective strategies for researching potential biological solutions. Many designers lack this appreciation, or are unable to translate their understanding of the evolutionary process into search heuristics. We present a short list of how to search biological systems productively given the constraints of the evolutionary design process.

- Biological functions evolve in response to a challenge faced by organisms. Some human problems may have no direct analog to ones that confront organisms.
- Evolution is "satisficing" rather than optimizing. A given solution need only be better than the existing one - it may not be the best solution. Searching broadly and understanding the principle (instead of simply copying an existing solution) generally is advisable.
- Solutions may be shared simply because animals are related, not because a given solution is the only one. Searching broadly is required to establish both the generality and robustness of a given biological solution.

Marc Weissburg is a founder and co-director of the Center for Biologically Inspired Design at the Georgia Institute of Technology.

Cognition in Biologically Inspired Design - Part 2 *(Ashok Goel)*

Although lack of information about biological systems is often considered a key inhibitor, tools and repeatable methods are also essential if we are to become proficient at bio-inspired design. When new fields are developed, existing methodologies can sometimes be adapted from other disciplines that are comparable or familiar to designers. A better approach involves studying how designers go about designing within the new field.

As described in September 2010 newsletter, "Research on design cognition is interested … in how … designers behave, think, perceive, act, communicate and learn when designing". It investigates what designers bring to a situation, the models they use and develop, how their work relates to the world around them and how they collaborate. In comparison to a generalized 'best practices' approach, design cognition takes into account the diversity of designers and the context in which they work.

There are other fields (such as design theory) that explore similar issues. Research on design cognition makes specific commitments both about the research end products and about its methods of investigation. The products of a design cognition study should include a detailed and consistent account of the information processing occurring in the design phenomenon or behavior. The methods should be empirical and evidence-based, ranging from observational studies to controlled experiments, neuro-imaging and computer simulations.

Cognition in Biologically Inspired Design … *(continued)*

For four years, the Georgia Tech's Design and Intelligence Laboratory and Center for Biologically Inspired Design have studied interdisciplinary teams of designers and biologists engaged in semester long projects as part of a senior level Biologically Inspired Design course (BIOL/ME/PTEF/ISYE 4740) taught by CBID faculty. The team has:

- developed consistent information processing models of biologically inspired design,
- compared the models with case studies of biologically inspired design practice as described in the literature,
- used the models to build computational tools for supporting education in biologically inspired design, applied the results to further refine the research.

The team has developed six preliminary findings on the processes of biologically inspired design involved in cross-domain analogies, the transfer of knowledge from the domain of biology to the domain of technology.

1. Co-evolution of Problems and Solutions
Problems and solutions in biologically inspired design typically co-evolve. That is, while a designer's initial understanding of a problem may result in the generation of an intermediate solution, the initial solution in turn may result in a better understanding of the problem. In contrast to situations involving well-defined problem/solution spaces, bio-inspired design may be particularly useful in dealing with complex or 'wicked' problems.

Salustri, Rogers and Eng in Designing as Balance-Seeking Instead of Problem-Solving argue that design problems often require approaches that a layperson typically does not associate with problem solving. Interesting problems are often not static even after the requirements have been 'frozen'. Solutions may not completely resolve the problem, in that they may modify the problem condition. Algorithms or heuristics may not be available. As problems become more complex, designers need to become more comfortable with "the idea of coevolution of problem and solution, where the act of solving a design problem illuminates the problem itself." Bio-inspired design may prove useful not just in providing specific solutions but also in supporting this design process. Architects may have been particularly attracted to biologically inspired design due to the nature of the problem/ solution space in which they work.

2. Compound Analogies
Problem decomposition is an important aspect of design in general. In biologically inspired design, analogical transfer of knowledge from biology to technology occurs at many levels of problem decomposition. This leads to a process where many analogies are composed into a solution. In contrast, many case studies of biologically inspired design that are reported in the literature are based largely on a single analogy, such as superhydrophobic paints based on the superhydrophobic properties of lotus leaves. As more complex problems are tackled, the translation from biology into design may be equally complex, requiring broad insight into both the nature of the problem and the biological principles.

3. Problem-driven and Solution-based Design Processes
Biologically inspired design often engages two different processes with different starting points. While problem-driven design starts with a technological problem and ends with a solution to it, solution-based design starts with a biological solution and ends with a technological problem and solution.

Most people consider design to be problem-driven. In contrast, the majority of case studies involving biologically inspired design are solution based, although this may be due to the current state of knowledge and expertise in the field. Understanding both processes and how they complement each other may provide fruitful insights to both biologically inspired design and design in general.

4. Transfer of Functions and Causal Mechanisms
Analogical transfer from biology to technology in biologically inspired design typically pertains to knowledge of functions and causal mechanisms of biological systems. Identifying appropriate biological systems is often based on knowledge of functions. Units of knowledge that are transferred often pertain to causal mechanisms that result in accomplishment of these functions. Thus, understanding and constructing models of biological systems in terms of their functions and causal mechanisms is a critical part of biological inspired design.

We are developing an interactive tool called DANE (for Design by Analogy to Nature) for supporting transfer of functions and causal mechanisms. DANE provides access to a library of Structure-Behavior-Function (SBF) representations of biological systems. An SBF model of a system informs the designer about the function of the system (or what the system does), the causal mechanisms in the system (or how the system works, called behaviors in SBF terms), and the structure of the system (or what the systems is made of). A paper analyzing how students of the Fall 2009 CBID course used DANE will be published shortly (see **Suggested Readings** below).

Cognition in Biologically Inspired Design … *(continued)*

5. Multimodal External Representations
Interdisciplinary teams of designers engaged in biologically inspired design typically use rich, intricate, multimodal external representations including drawings and equations. These external representations play an important role in communication among biologists and engineers who often use different terminology and have different perspectives on design.

Drawings and annotated diagrams in particular appear to help develop shared mental models of biological and technological systems that are accessible and meaningful to both biologists and designers. These shared models can help communicate not only technical details but also outcomes and goals. The diagram (based on a drawing made by a student project design team) links a wide range of biological information on the left with the final engineering solution on the right.

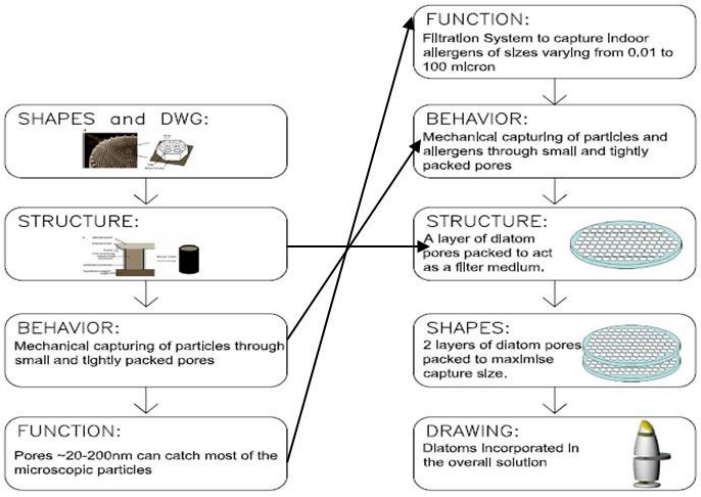


Figure 1: Design Trajectory of the Eye in the Sea (from the November 2008 issue of the *BioInspired!* newsletter)

6. Situatedness in Information Worlds
Although design in general is characterized by relatively complete field-specific knowledge easily accessible to designers, biological information is typically found through textbooks, journals and expert sources that are difficult for designers to find, understand and apply. Databases such as AskNature.org help bridge the gap, but it is not always easy to translate this material into useful design advice. Researchers such as Dr. Li Shu of the **Biomimetics for Innovation and Design Laboratory** are developing natural language tools to search the existing biological knowledge base.

Our findings cover only a small portion of biologically inspired design, specifically the early conceptual design of engineering systems. Although we expect that at least some of these findings are generalizable to other domains such as architecture and computing, this is yet to be empirically established. Secondly, these results are preliminary: we will know more about their robustness and reliability only after we have used and confirmed them in many biologically inspired design situations. Finally, we need to relate our work to the vast literature on design cognition in general. Much work remains to be done!

Suggested Readings

- Michael Helms, Swaroop S. Vattam & Ashok K. Goel. Biologically Inspired Design: Products and Processes. *Design Studies*, 30(5):606-622, September 2009.
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Ashok Goel directs the Design & Intelligence Laboratory at the Georgia Institute of Technology.

Skype Community Call: 'Forest Fractal' *(Faye Yoshihara, Janice McDougall, Norbert Hoeller)*

Can biomimicry help us develop better business and organizational models? Faye Yoshihara hosted a Skype conference call on October 21st to discuss business models that support sustainable development. Janice McDougall added her perspectives on creating humane organizational structures that help promote sustainable businesses.

The ultimate goal of taking a bio-inspired approach to business processes is to encourage more fundamental changes in the way businesses work rather than focusing only on their products or services. Faye's experience suggests that some of her recent graduate students feel that the culture of large business is toxic, both in terms of personal impact and environmental consequences. The graduates feel limited in their options to work in environments that encourage new approaches to business.

Those of us on the call believe that biomimicry can help provide compelling and tangible business and organizational models to replace the current sports and military analogies. Rather than focusing on competition, efficiency and short-term profitability, biomimicry would suggest a greater emphasis on inter-dependence, effectiveness and resiliency.

A better appreciation of the importance of natural systems can also lead to new business opportunities. Forest Fractal grew out of Faye's interest in the ability of eco-tourism to support sustainable and restorative development. She has been developing business-to-business connections that generate increased sustainable livelihoods, such as an Indonesian project to replant a logged area. In addition to providing a local source of wood, the project introduced income-producing plants (including shade grown coffee and spices) that in turn increase biodiversity. The picture above shows degraded land on Mount Muria in North Central Java that is being restored by the Jepara Forest Conservancy, while the one on the right is an example of the ecological diversity and downstream water needs dependent on the project.

Faye has used a number of high level analogies from nature with her MBA and MFA (Masters of Fine Arts) students, such as temperate forest trophic levels. She has used watershed models to explore the connections between rural/urban and north/south. Lacking are more detailed operational models that could be applied to specific problems. Understanding the context and mapping to an analogy can be challenging – how should a business balance the global market (using analogies from migrating species) with a more local focus? Is a biologist on the team essential to effectively introduce bio-inspired design principles in discussions of organization design and structure?

The discussion touched on how concepts from biomimicry could best be introduced into business. Should concepts be incubated in the educational world or go through early testing in the real world? Should we focus on organizations in crisis or does that increase the risk of getting involved in 'green-washing'? Is it possible to work from outside an organization or is it necessary to be fully embedded to be effective? Can changing organizational structures be an effective path to building better products and services? Although dealing with organizational structures and business models introduces significant complexity, this path may offer the best opportunity to advance beyond 'going slower in the wrong direction'.

Skype Call Participant Perspectives

Faye: It was great to have a thoughtful dialogue about how to overcome the challenges we all face as we try to integrate bio-inspired strategies into the whole of business operations. I discovered colleagues are facing some of the same challenges that I've encountered and the format of the call allowed for us to gravitate to a rich discussion on topics of mutual interest. I even came out of the call with some new contacts, an unexpected but welcome bonus.

Janice: A key value of the call was connecting with someone who is farther along the "operationalization" scale than I, whose challenges are thus 'next generation'. This gave me ideas on how to move my practice forward and to foresee what might be coming down the road. It also provided food for thought regarding how to most effectively introduce new methodologies of thinking and doing.

- Does the system have to be in "crisis" before room is made for the exploration of alternatives? What constitutes crisis may be unique to each organization, from a personal insight at the CEO level to an industry wide crisis in the case of extraction industries.
- How do we make the practice of biologically inspired design support other organizational goals rather than being an end in itself?
- Rather than looking for the "best place to start" (such as at the design level or at the organization level), should we follow the energy for change?

'Forest Fractal' … *(continued)*

Norbert: Although both Faye and Janice felt product designers had an easier time of applying biomimicry, I believe the many of the problems they articulated apply across disciplines. Many designers want to help solve pressing problems but often feel limited in the amount of influence they can exert. All designers would benefit from models that go beyond inspiration to provide context-specific guidance on developing better solutions. As they deal with more complex problems, designers are increasingly called upon to balance economic, environmental and social requirements where direct analogies to nature are difficult to find. Ultimately, designers want their solutions to be widely used, which often means that many of the organizational issues addressed in the call need to be resolved.

Suggested Readings

- Restoration Development "takes advantage of positive synergies between ecological restoration and sustainable livelihoods … to overcome the apparent conflicts between environmental conservation and economic development"
- Tropical Salvage "create good, steady, eco-positive jobs … protect the world's remaining primary tropical forests … advocate for best responsible social and environmental practices". The pictures below show wood being salvaged from rivers and turned into fine furniture.

- Forest Fractal Projects in Incubation are "an exploration of how art can interpret science in a manner that captures the imagination and motivates collective action on global issues such as climate change, invasive species, rural poverty & flight and land stewardship."
- *Resilience Thinking: Sustaining Ecosystems and People in a Changing World* (Brian Walker, David Salt) is a good resource for understanding how to manage human-ecological-industrial systems in a changing environment.

Faye Yoshihara specializes in brokering cross-sector partnerships and supporting start-up social enterprises. She recently launched Forest Fractal, LLC, a social enterprise dedicated to the restorative economy, working in forest biomes to support sustainable development.

Janice McDougall is a partner in Goodman, McDougall & Associates Ltd., a Human Resources consulting firm. She offers total rewards and facilitation consulting services in order to help clients make the work experience a great one for their staff, one that allows staff to meet their needs, fulfill the organization's goals and contribute to society.

Norbert Hoeller is an independent researcher with a particular interest on the process of bio-inspired design. He is a director of BioDreamMachine and founded the Bio-Inspired Design Community.

Calendar of Public Events

Date	Location	Event
Jan.29, 2011	webinar	Biomimicry in Higher Education
Mar. 13-20, 2011	Uvita, Costa Rica	Costa Rica Biomimicry and Design Workshop #1
Mar. 21-23, 2011	Stanford University, CA	AAAI 2011 Spring Symposium: Artificial Intelligence and Sustainable Design
Mar. 24-31, 2011	Uvita, Costa Rica	Costa Rica Biomimicry and Design Workshop #2
June 6-7, 2011	Berkeley, CA	The International Society for Industrial Ecology (ISIE) will hold its 6th International Conference
June 27-30, 2011	Cleveland, OH	2011 Biomimicry Education Summit (dates to be confirmed)
Sept. 2011	Gibraltar Island, OH	Biomimicry Workshop
Dec. 2011	Lavasa, India	Biomimicry Workshop

Date	Location	Event

An online events calendar readable by anyone is available at http://bioinspired.sinet.ca/Events. Users who have registered on the site can post new events.

Call to Action

This section is intended for announcements and opportunities of particular interest to the BID Community as well as a broad range of ways in which members can help support the goals of the community.

Postdoctoral Research Scientist Positions at CBID
Georgia Tech has positions open in both Science Education and Design Cognition as part of the 2 year, NSF funded project "**Biologically !nspired Design: A novel interdisciplinary biology–engineering curriculum**".

Alliances and Partnerships
The BID Community cannot 'do it alone' – we need to actively cultivate alliances and partnerships. Community members are in an excellent position to make recommendations based on their unique knowledge and experience. Please visit http://bioinspired.sinet.ca/content/alliances-and-partnerships, post a comment and lend your support to what other members have posted using the rating system. Ideally, we should be targeting alliances and memberships that not only benefit us, but where the BID Community can deliver reciprocal value.

Recommend a Book, Paper or Article
We are all chronically short of time and there is simply too much information. If you find a book, paper or article that you found particularly insightful, post a new forum topic at Literature Exchange with pointers to the material and what you got out of it. You can also post comments to material that other members have reviewed.

Robin Rogers and Emer Natalio recommended that the BID Community sign up as an Amazon Associate. The program pays 4% of any Amazon book purchases initiated through links from the website, at no additional cost to the purchaser.

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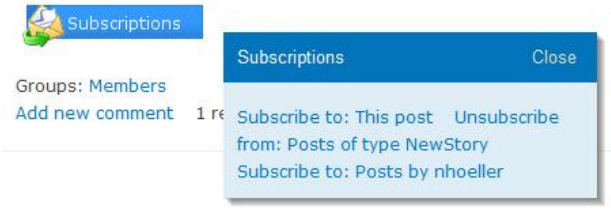
Community Conference Calls
Based on feedback from the 'Forest Fractal' conference call, we plan to schedule regular Skype conference calls in 2011. Suggestions are welcome, or even better, volunteer to host a call by posting a comment to Future BID Community Conference Calls.

Collaborative Article Development
One of the challenges in publishing the *BioInspired!* newsletter is finding good articles in time to meet the quarterly publish date. We will pilot a collaborative writing approach in 2011, posting ideas and drafts of articles early so that members can comment and contribute. When the articles are fully developed, they will be scheduled for inclusion in the newsletter. Click on http://bioinspired.sinet.ca/newsletter/8/9 to see what is available. Current articles include:

- BID Methodologies
- Commercializing Bio-Inspired Design
- Bio-Inspired Industrial Design
- BID Community "Participation Dividend"

If you want to subscribe to a specific article, mouse over the **Subscriptions** button at the bottom and then select **Subscribe to: This post**. You can also subscribe to all content of type **NewStory** to get notified of new and changed content of this type.



Ashok Goel, Petra Gruber, Norbert Hoeller, Janice McDougall, Tom McKeag, Eileen Stephens, Karen Verbeek, Marc Weissburg, Jeannette Yen