Biomimicry

TRAILS Summer Institute
Biomimicry, Bio-inspired Technology

What is Biomimicry?

"The term biomimicry is from Greek bios, life and mimesis, imitation. It represents the new focus on mimicking natural processes to find innovative solutions to complex problems; instead of focusing on what can be extracted from nature, biomimics pay attention to what they can learn from nature" McGregor, 2013, p. 58.

Misconceptions Regarding Biomimicry

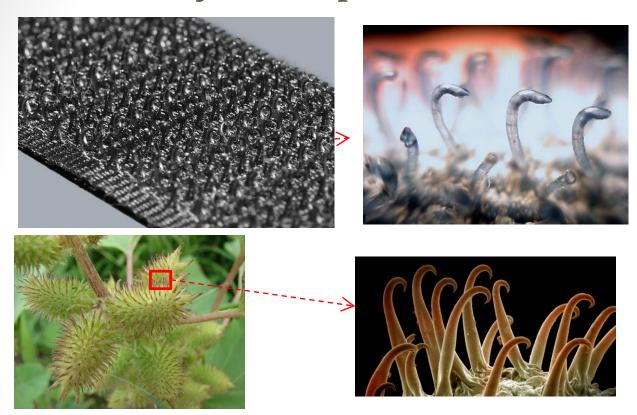
- Many mistake biomorphism (when something looks like nature) for biomimicry.
- Biomimicry occurs when something designed is inspired by <u>HOW something in nature</u> <u>WORKS</u>. Biomimicry begins with identifying the <u>function</u> that a design needs to perform and finding analogs for that function in nature (biological strategies) from which useful design ideas can be drawn.

(Gretchen Hooker, personal communication)





Biomimicry Example: Velcro



- George de Mestral's 1941 hunting trip in Switzerland while walking his dog in the mountains, he accidentally brushed up against some cocklebur plants.
- He quickly figured out why the seeds were so sticky by examining them under a microscope

Biomimicry Example: Gears

Planthoppers hop with a modified wheel: the gear.



Planthopper nymph

http://www.youtube.com/watch?v=cq0Mf2pt2XA

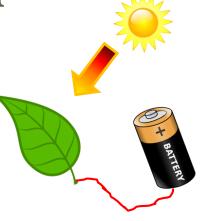
http://www.npr.org/2013/09/13/219739500/living-gears-help-this-bug-jump

Biomimicry in Design

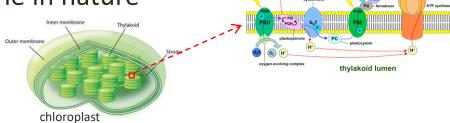
Nature has solutions,

how do we harness them?

• 1. Define the function to be designed for



2. Find ways function is done in nature



• 3. Design, test, reiterate



artificial leaf v.2

1. Define Process

What is the key process and outcome that are needed?

- -Do not focus on it looks like
 - biomorphism a separate design aspect
- -Reduce to the core processes

Example:

A very large building in a hot climate needs to have cooling and air circulation



1. Define Process

- Circulate air
- Cool the air

Don't think of how to modify existing commonly-used HVAC systems

(Traditional approaches are often fine, but we are in the innovation business)



2. Find Solutions in Nature

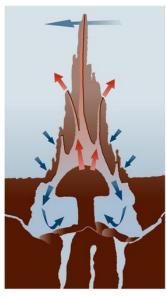
- Termites build nests that are passively cooled
- Warm air rises and leaves the nest, drawing in cooler air from tunnels that run deeper into cool moist earth
- Alter flow of air and cooling by constantly capping and opening structures

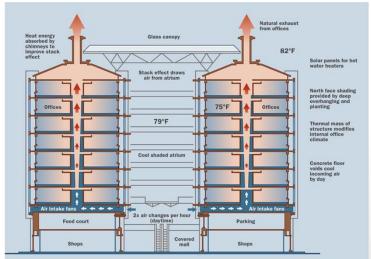


3. Design, Test, Reiterate

- Just kidding about the bees
- Building was designed to have passive air flow that mimics the air flow in a termite mound
- In the building, fans are needed to boost the movement of air.
 This is an example of scaling; the relative influence of different forces in nature changes with the scale you're working at.







3. Design, Test, Reiterate





Green building in Zimbabwe modeled after termite mounds

Biomimicry in Design

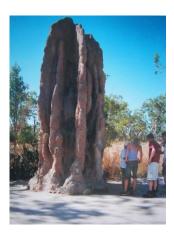
Nature has solutions, how do we harness them?

• 1. Define the function



• 2. Find ways done in nature





Biomimicry: A Tool for Innovation

 $Sue\ L.\ T.\ McGregor$ Transdisciplinarity and Biomimicry

62



Figure 3: Design Spiral Methodology (used with Permission).



Questions?

62

Sue L. T. McGregor Transdisciplinarity and Biomimicry

> THE CHALLENGE TO BIOLOGY DISTILL DISTILL THE DESIGN FUNCTION Design Spiral · Don't ask "what do you want to design?" · Instead ask "what do you want your design to do?" · Keep asking "why do you want your design to do that?" **EVALUATE EVALUATE YOUR DESIGN AGAINST** LIFE"S PRINCIPLES TRANSLATE Can your design adapt and evolve? • TRANSLATE TO BIOLOGY Does your design create conditions • · Identify the functions conductive to life? · Ask "how does nature do that function" How can you improve your design? • · Reframe the question · Define habitat conditions that reflect design parameters **EMULATE** DISCOVER · Translate Life's Principles into **EMULATE NATURES STRATEGIES** DISCOVER NATURAL MODELS design parameters Brainstorm multiple solutions . · Go outside · Consider both literal and Refer back to the discover phase • metaphorical models consider chimera designs · comb the literature Consult with biological experts • · Brainstorm with biologists Go back to your model and explore . · Create taxonomy of life's strategies more strategies

Figure 3: Design Spiral Methodology (used with Permission).