

EXAMPLES OF BIOMIMICRY:

From Jeremy Eddy

FORM:

Real life examples

1. sand burrs stuck to socks -> velcro
2. lily impellor: 50% less energy, 75% quieter. Same size fan w/1/2 the motor
 - a. salmon go through hydroelectric dams without getting chopped up
 - b. no cavitation up to 6000 rpm; good in human hearts
 - c. reduces limitations on computer size as dictated by overheating
3. forest floor version of carpet tiles
4. staybrex imitates stabilized bromine on kelp to keep off harmful marine microbes, eg on sewage pipe linings
5. thickness of adobe walls in homes matches distance of ground squirrel bedrooms under ground's surface (Columbia ground squirrels in Colorado)
6. fabrics with structural color (like some butterfly wings)
7. imitating photosynthesis: pentad, charge separation
 - a. organic thin film solar cell: spray photovoltaic stuff on your roof
8. namibian beetle collecting water from air; dry air reduces mold, makes it cheaper and easier to cool air
 - d. namibian desert beetle -> fog nets in Chile, Peru
9. lotus leaf: self-cleaning: dirt particles teeter on texture "mountain tops" drops of water collect dirt as they roll off leaf -> self-cleaning paints and other coverings
10. structural color: peacock: oly melanin!, next velcro, or better. eliminate nasty dyes -> fabrics with structural color
11. decreased drag a la narwhal tusk, shark skin, dolphin skin -> boat hulls, swim suits, airplane hulls
12. sail whose shape changes in different wind conditions a la bat or bird wing
13. hearing aid a la seesaw directional eardrums of small fly
14. bumps on whale fins (aka tubicles) -> tried on airplane wing -> increased fuel efficiency by 32%; thinks he can cut in half the cost of operating a wind turbine [Frank Fish, West Chester University, studies how organisms move through fluids]

Examples ripe for mimicry at the FORM level:

15. feather hook and barbule: sanitation of hospital flooring
16. stairstep sacrificial breakage
17. seed shape designed to travel easily thru gullet/GI tract; use as medicine vessel?
18. extremophiles: desert-dwelling scavenger ants
19. midge larvae: oxygen scavengers -> suffocate fires
20. palm frond in wind: ridges, easy tear between fingers
21. Differential growth in plant parts creates a "loaded spring" that flings ripe seeds for dispersal
22. jewel beetle: infrared pits under legs/body joint swell->nerve hair yanked -> sense forest fire 50 km away -> lay eggs in just burned trees

23. barnacle valve seal: NASA heart surgeons, plumbers, airplane doors, sewage release...
24. lazarus shark: tolerant of hypoxia -> drugs for stroke patients?
25. brazil nut husk -> better bicycle helmets
26. use gradients a la mussel thread springiness in radial belt car tires?
27. Materials that persist (only) as long as we need them (a la mussel byssus, tough outer sheath w/softer core, all eventually breaks down)

Things we already do that could be improved with nature's instructions:

28. countercurrent exchange; look at veins coiled around artery before returning to heart.

PROCESS:

Real life examples:

29. secrete
30. Liquid crystals (a la abalone shell) in many contexts; strong, tough, elastic
31. quantum inseparability across brains -> encoding for safe transport of documents
32. lucent: fiber optics w/no heat, no pressure, no toxics by imitating sea sponge
33. snail shell protein -> antiscaling (Donlar, TPA)
34. lily impellor: 50% less energy, 75% quieter. Same size fan w/1/2 the motor
 1. salmon go through hydroelectric dams without getting chopped up
 2. no cavitation up to 6000 rpm; good in human hearts
35. reduces limitations on computer size as dictated by overheating
36. steel manufacturers pour into molds with preexisting holes
37. magellan: antibacterial/antifungal protein from frogs, sharks that prevents infection
38. Fuji/Xerox doing color based on cuttlefish system
39. antibiotic resistance from sea purse emitting pheromones that jam bacterial communication signals
40. -bone repair a la self-healing in bone, using calcium phosphate-coated screws
41. sugar in Resurrection Plant turns to syrup (rather than crystal) when dry; doesn't burst cells -> vaccines stored w/out refrigeration [Bruce Rosser, Cambridge Biostability]
42. color in the carapace of a Japanese beetle is dictated by how tightly wound each helix is in a matrix -> one sheet of paper, imprintable on a light box, reusable ad infinitum [ASIT, Japan] (this means printing in full color without ink)
43. microbes glean metals from water for metabolism -> filters to pull metals from wastewater [MR3]

Examples ripe for mimicry at the PROCESS level:

44. water treatment for heavy metals could imitate mussels
45. manufacture at ambient temperatures using a water solvent
46. extrude pre-carpet liquid on site?
47. carpeting that grows stimulated by tread, a la gras?
48. feather: keratin in multiple forms, very flexible
49. rhino horn; composite of 2 forms of keratin

50. protist flagellum: rotary motor running on sugar?
51. nature grows holes rather than punching them out
52. python rib bones break by design when swallowing large prey
53. self-repairing proteins, eg heat shock proteins, self-healing rhino horn
54. self assembly a la abalone shell, snail shell
55. larvae excreting salt -> desalinization?
56. ingredients mixed JIT, eg toxic venomous ant, spiders making silk
57. caustic for a short time, break down fast
58. occasional input of energy feeds natural oscillation of midge wing to maximize efficiency
59. imitate body's prevention of kidney stones to minimize struvite accumulation in waste water treatment plants
60. embracing "mistakes"; also: organisms in stressful circumstances show an increased rate of mutation and adaptation
61. helix of mussel threads -> sticky matrix; craet skin, organs for patients?
62. could a car receive and respond to info like a spider on its web?
63. take advantage of available energy: could the free energy each time you step be used to recharge/repair your shoes?
64. -look at human kidneys for ways to prevent struvite accumulation in sewage treatment plants
65. -marine birds drink and desalinate water; also various insect larvae excrete salt
66. -holographic memory

ECOSYSTEM

Real life examples:

67. natural systems agriculture: Masanobu Fukuoka, Bill Mollison, Sunshine Farm
68. excess CO2 -> biodegradable plastics
69. Ray Anderson, Interface: let's mine landfills for textiles
70. -locust avoids collision [Claire Rind, U. Newcastle]
71. how would a gecko design for disassembly?; van der waals forces [Kellar Autumn, UCB]
72. how would red kelp stay well? small protein interrupts bacterial communication; says "don't land here"; doesn't encourage bacteria to build immunity [Peter Steinberg, Biosignal]

Examples ripe for mimicry at the ECOSYSTEM level:

73. company like an ecosystem: stay where you are, recycle everything. a sense of place: using local resources (all behavior is local, see my speech points) (tell Paul Hawken's coke can journey story). embody the truth that everything is context-dependent.
74. the network effect; conversation between efficiency and diversity. analogy between microsoft virus susceptibility and monocropping in a field
75. thinking pandimensionally simultaneously. structures performing multiple functions. redwoods gather up to 4 inches water in a night: mitigate flooding.
76. Materials that persist (only) as long as we need them (a la mussel byssus, tough outer sheath w/softer core, all eventually breaks down)

Things we already do that could be improved with nature's instructions:

- 77. outsourcing
- 78. feedback mechanisms, embracing "mistakes". organisms in stressful circumstances show an increased rate of mutation and adaptation
- 79. upcycling: preservation of high value forms during recycling/decomposition. use available, low intensity energy to both build and disassemble materials vs. HEAT/BEAT/TREAT

Biomimicry is...

- the conscious emulation of life's genius. –JB
- a way of seeing, a la scientific method. It is a lens to see pattern and its dynamics
- mimicking what works. We're not making this up. We're not the first to do it; organisms mimic what works in each other all the time.
- nothing new (Da Vinci, Fuller, Goethe, Paxton...), but an important new emphasis.
- asking for the recipe, asking for designs, relationship strategies
- solving for pattern (Wendell Berry), solving many problems at once
- designing solutions from within the system that embeds us. it is integrated solutions that take advantage of ancient R&D rather than guesswork at solutions from within a foreign system of industrial ecology mindset
- a path, an evolving system that is a process of biomimicry itself. it needs to grow in context, to design from within the system
- recognition of the genius that surrounds us. we are asking to be let in past the outer teachings to the inner genius. This requires communion
- the alignment of self interest with "doing what's right"

Biomimicry is NOT:

- getting spider silk from goats
- hijacking stuff from nature because it happens to function in a totally different context
- cultivating a USE relationship with nature. (rather, it is a communion relationship)
- an engineer shaking a rosebush

Biomimicry as environmental education:

- puts environmental education in perspective; what is the impact of draining ogalala water table: Look at affected organisms to see the nested relationships within a rapidly changing physical context.
- what's the difference between listening to a lecture on how a plane flies just for the sake of knowledge vs. when you're about to fly it? This experiential reality needs to be combined with careful thinking about what's important to understand.
 - Is it the steps of the krebs cycle? My answer: nature functions at a variety of nested levels, nature makes use of what is available eg. consumers reverse photosynthesis chemistry machinery to create digestion, organic using inorganic a la polymer crystals, changes due to physical processes a la desiccation; nature creates conditions conducive to life

Julian Vincent: “Shape is cheaper than materials.”

Janine: “There are no *things* in nature; life makes things disappear into relationships.”

Janine: “When you see a structure in nature, assume there’s wisdom in it.”