Life's Design Principles for Creating Community

How does nature create communities that behave in ways that sustain themselves?

Challenge: How Does Nature Create Community?

Function: We want to create community using Nature's strategies to influence, motivate, coordinate, and cooperate

	Function	Strategy	Design Principle	Life's Principles Emphasized	Our Design – Implementation Actions/Policies	Barriers Addressed
1	Influence (primitive) *Create Community*	Ancestral fig tree species produce large numbers of large flowers to release abundant pollen onto wasps that disperse the pollen to fertilize the tree's fruit. These passively pollinated species produce so much pollen that few of the wasps that visit them are pollen-free, so sanction mechanisms against cheating are unnecessary.[1]	Communities that are rich in benefits can function without sanction mechanisms to deter cheating.	✔ Integrate Development & Growth	Dispersing resources. Sharing? Leveraging? Cooperation? • Free-cycle • Swap meets • Eco-cycle	Laziness Lack of Knowledge Cultural Experience
2	Influence (evolved) *Create Community*	Highly evolved fig tree species produce smaller numbers of flowers and less pollen and they depend on specialized wasps that actively pollenate their fruit. Wasps that don't do their job suffer sanctions in the form of reduced reproductive success.[2]	Highly specialized cooperative communities need effective sanction mechanisms to maintain themselves.	✔Evolve to Survive ✔Be Resource Efficient ✔Adapt to Changing Conditions	• Smaller trash containers; larger & more convenient recycling containers (Make it more difficult to throw away than recycle) • Identify "Champions" within in each community (Power mapping/peer influence)	Ideology Laziness Lack of Knowledge Cultural Experience Lack of Sanctions
12	Influence *Maintain Community Fitness*	The tropical tree *Acacia drepanolobium* associates with four symbiotic ant species whose short-term individual effects range from mutualistic to parasitic. Tree fitness is enhanced by partnering sequentially with sets of different ant symbionts over the life cycle of the tree, including ant species that differ in the short-term benefits or costs they impose on their host trees. None of the species is a "perfect" partner. Occupancy by different ant species over the life cycle of the tree influences tree demography; fitness was highest when trees partnered with all four ant species over their lifetimes and typically declined with the removal of one, two or three ant species. Some "parasites" are actually beneficial partners when considered within the broader context of multiple symbionts and the full life cycle of the host.[3]	In a long-lived community or system, the succession or sequence of actors or can contribute to the survival of the system in different ways, depending on the life stage of the system or community. The effects of all the partners embedded in a mutualistic network have to be considered together in order to understand and shape the way the network effects the system or community that the partners operate within.	✔Evolve to Survive ✔ Adapt to Changing Conditions ✔Integrate Development & Growth ✔ Be Locally Attuned & Responsive	Find ways to build upon each community's strengths and values → if each segment can contribute something→ build community, increase participation (generally, specifically) • Identify Champions • Power mapping • Peer influence to increase cooperatation	Ideology Lack of Knowledge Cultural Experience Lack of Sanctions

[1] Jandér KC; Herre EA. 2010. Host sanctions and pollinator cheating in the fig tree–fig wasp mutualism. Proc. R. Soc. B. 277(1687): 1481-1488.
[2] Jandér KC; Herre EA. 2010. Host sanctions and pollinator cheating in the fig tree–fig wasp mutualism. Proc. R. Soc. B. 277(1687): 1481-1488.
[3] Palmer TM; Doak DF; Stanton ML; Bronstein JL; Kiers ET; Young TP; Goheen JR; Pringle RM. Synergy of multiple partners, including freeloaders, increases host fitness in a multispecies mutualism. PNAS. 107(40): 17234–17239.

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	Motivate					
6	Coordinate	Cell-to-cell communication between bacteria is mediated by signal molecules that trigger changes in gene expression in response to population density and other factors. Bacteria are not limited to communication within their own species but are capable of "listening in" and "broadcasting to" unrelated species to intercept messages and coerce cohabitants into behavioral modifications.[4]	Quorum sensing mechanisms enable populations to instigate a collective behavioral response to environmental or other signals or challenges.	✔Adapt to Changing Conditions ✔Be Locally Attuned and Responsive	• Identify Champions w/in each community • "It's Our Park" campaign (build identity with Park, increase commitment) • Conduct surveys/focus groups/interviews to Identify (invisible) barriers	Ideology Lack of Knowledge Cultural Experience
8	Coordinate *Create Community/ Collaborate*	The Industrial Symbiosis network in Kalundborg, Denmark, reduces the intake of vergin materials and lowers the production of waste through a collaborative web of knowledge, material and energy exchanges. Social Network Analysis indicates that these exchanges evolved informally over time, initially in response to limited availability of water resources in the area.[5]	The social networks necessary to provide the exchange of knowledge and information required to successfully establish and sustain community need to have a reason to exist before they can be institutionalized.	✔Evolve to Survive ✔Be Resource Efficient ✔Integrate Development & Growth ✔Be Locally Attuned and Responsive	• Reason to exist = need or requirement. • Make economics arguments to Operations/Management • Set Park Policies re: o Green Purchasing o Restrict non-recyclables • Work with Schools/kids	Lack of Knowledge Lack of Sanctions Cultural Experience Lack of Support
3	Cooperate	Sea anemones host anemonefishes (genus *Amphiprion*), which afford the sea anemone some degree of protection from other fish that prey on anemones because the anemonefishes are territorial and drive them away. In turn, the anemonefishes live within, and depend on, the sea anemone's stinging tentacles for protection against predation by fish that eat anemonefishes. [6]	Communities depend on mutually beneficial relationships. Each member of a mutualistic community must benefit from being a part of the mutualistic relationship, whether it is for nourishment, protection from predators or environmental stressors, or to meet other life needs.	✔Evolve to Survive ✔ Integrate Development & Growth ✔ Be Locally Attuned & Responsive	Find ways to build upon each community's strengths and values → if each segment can contribute something→ build community, increase participation (generally, specifically) • Identify Champions • Power mapping • Peer influence to increase cooperatation	Ideology Lack of Knowledge Cultural Experience Lack of Sanctions
4	Cooperate *Communicate*	Foraging honeybee colonies successfully collect more nectar and pollen by communicating the location of nectar sources in areas with high species richness or abundant resources, respectively. [7]	Communities that communicate about the location and richness of their resources make more effective use of resources that surround them.	✔Be Resource Efficient ✔ Be Locally Attuned & Responsive	• Identify Champions w/in each community • "It's Our Park" campaign (build identity with Park, increase commitment)	Ideology Lack of Knowledge Cultural Experience

[4] Atkinson S; Williams P. 2009. Quorum sensing and social networking in the microbial world. J R Soc Interface. 6(40): 959-78
[5] Domenech, T., & Davies, M. (2011). Structure and Morphology of Industrial symbiosis networks; The case of Kalundborg. *Procedia Social and Behavioral Sciences , 10*.
[6] http://www.sci.sdsu.edu/classes/biology/bio515/hentschel/PDFs/Opala(2003).pdf
[7] Donaldson-Matasci, M., & Dornhaus, A. (2012). How Habitat affects the benefits of Communication in Collectively Foraging Honey Bees. *Behavioral Ecology and Sociobiology , 66*, 583.

	Function	Strategy	Design Principle	Life's Principles Emphasized	Our Design – Implementation Actions/Policies	Barriers Addressed
5	Cooperate	Mangrove (*Mymecodia*) plants provide shelter to ants within the tunneled areas in stems. Ants provide scarce nutrients from their debris to epiphytic plants and fungi growing on the mangrove tree. Ants also tend the larvae of *Hypochrysops* (butterfly) who feed on the leaves of the plants.[8]	A successful and diverse community flourishes in a system where mutualism (differing species interact to provide benefits to each other) is present. Services members of the community provide include transforming wastes/ materials/nutrients, and transporting them to places where others can use them.	✔ Evolve to Survive ✔ Be Resource Efficient ✔ Adapt to Changing Conditions ✔ Integrate Development & Growth	Ant waste equals plant food/energy (or benefit). At GRCA, we have one example where the oil from restaurant fryers is collected and used to power the steam engine for the Grand Canyon Railway. What other wastes can we use for energy to build community? Could be the "Free Box" idea where items (clothes, electronics, kitchen stuff) can be left for others to use? Collect old dishes, flatware to use for employee parties. Community Swap Meet. Does everyone who participate benefit?	
7	Cooperate *Recycle All Materials*	Waste Management, inspired by the interaction of organisms in soil ecosystems, aspires to move toward a goal of zero waste by turning the waste it collects into products like alcohols, organic acids, biofuels diesel and other chemicals. By creating products from waste, the company seeks to go beyond recycling and get the most value out of what normally would be put into landfills.[9]	Cooperative relationships among parts of a system use diverse, readily available materials and energy to nourish and sustain the entire system. A nature-based system would normally upcycle waste into more valuable products instead of downcycling it by using it for fuel or other less resource efficient purposes.	✔ Be Resource Efficient ✔ Integrate Development & Growth ✔ Use Life-friendly Chemistry	Create community – shared vision • Leadership • Interviews, etc. to identify barriers to community → increase desire to cooperate and participate • Zero Waste parties/events Establish Park Culture via Policies • Leadership sets policies o Green purchasing o Restrict sale of non-recyclables o Sanctions for non-compliance	Ideology Lack of Knowledge Cultural Experience Lack of Support Lack of Sanctions
9	Cooperate *Create Community/ Collaborate*	Synergistic interaction between plants and microbial communities in rhizospheres benefits both microorganisms through provision of nutrients by root exudates, and plants through enhanced nutrient uptake and reduced toxicity of soil toxicants. [10]	A local community of interdependent specialists can sustain one another by closing the waste-nutrient cycles within the community.	✔ Evolve to Survive ✔ Be Resource Efficient ✔ Integrate Development & Growth ✔ Use Life-friendly Chemistry	Share resources • Free-cycle • Eco-cycle • Swap meets	Ideology Laziness Lack of Knowledge Cultural Experience

[8] http://www.asknature.org/strategy/2639d706b8ac175f18c2e5bf72bc6875
[9] http://www.asknature.org/product/fc4d0678aa5aba1b8195ec177bcaafce

[10] http://www.asknature.org/strategy/8ea24c1f1872710dbac52e986c6d24f6

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10	Cooperate *Distribute Resources*	Hermit crabs exhibit a variety of shell vacancy chain behaviors that determine how reusable resources are distributed through the population. [11] Social contexts like population density alters shell acquisition behaviors and signaling cues (e.g., odors from dead gastropods or conspecifics) prompt aggregations around potential shell sources, which can form the nucleus for a vacancy chain in which several members of the population improve their situation by finding a shell that is a better fit. ("Vacancy chain theory applies to any system where critical resources are discrete, limited, and reusable.")	Scarce reusable resources can be efficiently allocated within a community by creating the social contexts and signaling cues necessary to trigger a vacancy chain.	✔ Be Resource Efficient ✔ Adapt to Changing Conditions ✔ Integrate Development & Growth ✔ Be Locally Attuned & Responsive ✔ Use Life-friendly Chemistry	Share resources • Free-cycle • Eco-cycle • Swap meets	Ideology Laziness Lack of Knowledge Cultural Experience
11	Cooperate *Create Community*	"Key engineers" uniquely create habitat and resources that support a multitude of other species in ecosystems. There is evidence for the existence of functional engineering roles that can be fulfilled by alternative species, raising the possibility that ecosystems may be preserved or restored by addressing functional engineering roles rather that the particular species that perform them.[12]	Human-designed systems can perform the functions of key engineers to restore or preserve ecosystems that support multiple species and functions.	✔ Adapt to Changing Conditions ✔ Integrate Development & Growth	Are there things each community could to help the other communities, build relationships/community? Result in increased energy and positive attitudes towards each other/participation	

[11] Rotjana RD; Chabot JR; Lewis SM. 2010. Social context of shell acquisition in *Coenobita clypeatus* hermit crabs. Behavioral Ecology. 21(3): 639-646
[12] http://lalandlab.st-andrews.ac.uk/niche/pdf/Publication99.pdf