NATURE CARDS

IDEO IN COLLABORATION WITH **BIOMIMICRY 3.8**

DESIGN INSPIRATION FROM NATURE

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As we widen our lens to view more of the world around us, we're inspired by patterns in nature as well as those of human culture. These cards embody an emerging set of concepts from biology and ecology that have been inspirational in a broad range of design challenges. Some represent knowledge about life and living systems; others reference strategies observed in nature. Whatever their origin, we hope you'll find them helpful, provocative, and refreshing in framing your design challenge, revealing new design opportunities, and choosing among multiple options.

ADAPTATION

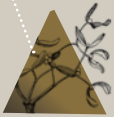
PROPAGATION AND CHANGE OVER TIME

Selective Pressures
Slippery Genes
Dispersal or Devotion
Active Shapes (2)

ENDURANCE

SURVIVAL THROUGH ADVERSE CONDITIONS

Efficiency or Resilience
Ecological Succession
Dynamic Structure
Living Layers



RELATIONSHIPS

INTERDEPENDENCIES WITHIN AN ECOSYSTEM

Keystone Species
Ecosystem Engineer (2)
Mutualism
Surge Strategy

COMMUNICATION

INTELLIGENCE AND LOCAL RESPONSIVENESS

Simple Rules (2)
Emergent Networks
Contextual Signals
Passive Indicators

GETTING STARTED

There's no prescription but here are a couple of things you might try.

Think about your design challenge. Is it related to Communication? Environment? Service? Organization? Packaging? Manufacturing? Technology integration? Review the 4 categories for the most intuitive connections. *Adaptation* could be a good place to start for a manufacturing project. For organization design, perhaps start with *Relationships* or *Communication*. For packaging, look at *Adaptation* and *Endurance*.

Or deal the cards to your team and have each person browse them with the challenge in mind. Some will pique your interest to talk about a new topic, delve deeper, or spur an idea. They might even stir you to get out of your project space to experience nature!

Trees create a canopy habitat that supports abundant species...

RELATIONSHIPS

Ecosystem Engineer

Some organisms dramatically alter their environment to create a greater diversity of habitat and species.

As trees grow, their trunks and branches create habitats for many other living things. In the rainforest there are species that live and move exclusively within the canopy provided by trees, living on insects, fruits, and seeds from the trees and from epiphytes growing within their branches.

YOU MIGHT ASK

What kind of habitats and diversity do we seek to create?

What structures could create the conditions for new behaviors or new populations to thrive?

DIVERSIFIED HABITAT

To connect better with 18 to 35-year-olds, a long-established insurance company created a very non-traditional environment—a café serving cappuccinos alongside free life coaching and financial advice.

Beaver activity forms new habitats for other species...

RELATIONSHIPS

Ecosystem Engineer

Some organisms dramatically alter their environment to create a greater diversity of habitat and species.

Beavers are archetypal ecosystem engineers. They modify the environment by clear-cutting areas of woodland and damming streams. Different species of plants, fish, and other creatures are able to thrive in the region of a beaver dam.

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DIVERSIFIED HABITAT

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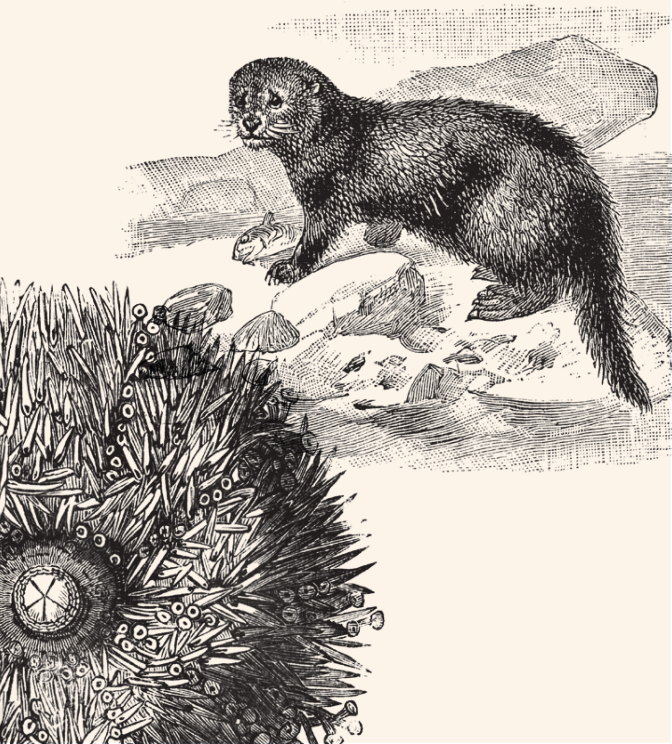
An entire ecosystem thrives because sea otters feed on sea urchins...

RELATIONSHIPS



Keystone Species

Some species play a disproportionately critical role in maintaining the structure of an ecological community.

Sea otters keep sea urchin numbers in balance, allowing kelp beds to thrive. Without sea otters, sea urchin populations grow very quickly and eat up entire kelp beds displacing the many fish species that spawn there.

YOU MIGHT ASK

Are there keystones—people, places, or things—in our ecosystem?

What might we do to augment their effect?

What do other elements in the ecosystem need in order to thrive?

COMMUNITY CATALYSTS

The US Green Building Council structured communication in its chapter organization around "keystone experts" who invite participation, foster relationships, and share content across the organization.

Mistletoe seems parasitic, but benefits the Juniper tree in the long term...

RELATIONSHIPS

Mutualism

Relationships in nature tend to evolve from being competitive for resources to becoming mutually beneficial, allowing an ecosystem to function sustainably over time.

Mistletoe is defined as a parasite because it lives on the juniper tree, and would perish without it. But, over time, a juniper afflicted with Mistletoe attracts significantly more seed-eating birds than others, enhancing seed dispersal and spreading its offspring far and wide.

YOU MIGHT ASK

Are there mutual benefits in an apparently competitive situation?

Will any useful by-products emerge from our design?

Are there opportunities to create a cooperative ecosystem?

SYMBIOTIC PRODUCTION

The plastic for Stonyfield's yogurt cups is developed by Preserve who, after use, recover the cups to create toothbrushes and other products from a predictable supply of high-grade recycled material.

An acorn glut overwhelms predators, ensuring propagation of the oak…

Surge Strategy

Some preyed-upon organisms cope with predators by producing an oversupply of offspring, making it impossible to eat them all.

Every dozen or so years, oak trees have an acorn surge, called a "mast." Squirrels and other predators consume only so many, leaving plenty to germinate. In the following year the oaks produce few or no acorns, then causing the predator population to drop.

YOU MIGHT ASK

To whom are we prey? Or predator?

How might we create a surge in interest?

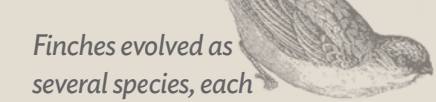
How might we overwhelm our competition?

CYCLIC AVAILABILITY

The sneaker industry periodically offers limited quantity re-issues of popular models from years prior. "Sneakerheads" clamor to buy a pair or two to add to collections or re-sell in the after-market for profit.

Finches evolved as several species, each most fit for certain types of food…

ADAPTATION



Selective Pressures

Conditions, such as food sources and climate, result in natural selection and evolution, as species adapt over generations to fit an environment.

As noted by Darwin, biodiversity among finches is an example of available food as a selective pressure. Several distinct species evolved over time as each specific food source— seeds, grubs, or leaves for example— favored birds with a specific shape and size of beak.

YOU MIGHT ASK

What will differentiate this from others in the ecosystem? What is its niche?

How might our solution "fit" or adapt to other geographic, technological, or cultural contexts?

DISTINCTLY DIFFERENT

Swiss kitchen gadget maker, Zyliss launched its new line in the USA, in stark contrast to OXO's successful iconic black-handled Good Grips, with glossy white handles, each uniquely shaped for the task at hand.

So many different looking dogs; it's all in the genes...

ADAPTATION

ADAPTATION

Slippery Genes

A species' genome is referred to as "slippery" when DNA sequences for certain traits are copied with low fidelity, resulting in large physical differences between individuals.

Dogs are a species with a "slippery genome" enabling the vast range of physical traits to evolve over the brief period of their domestication. Within a few generations, it's possible to select for entirely new specialized breeds, such as the Sulimov dog for detecting explosives.

YOU MIGHT ASK

How slippery is the DNA of your brand? How flexible is its expression for future conditions?

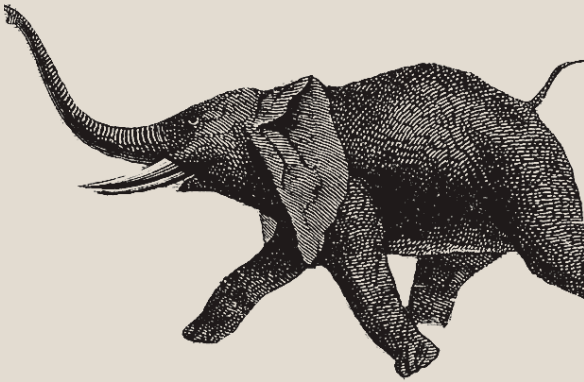
How might your design principles support variation in expression?

BRAND FLEXIBILITY

Converse retail design strategy was based on its brand as a platform for creative expression. For each of its US stores, employees, customers, and local artists contributed to a distinct and uniquely local character.

A single calf or hundreds of turtles, reproduction requires a strategy...

ADAPTATION



ADAPTATION

Dispersal or Devotion

Organisms are classified by reproductive strategy. An r-type organism disperses large quantities of young, usually in conditions that change unpredictably. A K-type organism devotes energy to quality care of a few, usually in more stable conditions.

Sea turtles are typical r-type organisms, depositing hundreds of eggs that give rise to tiny turtles, many of which don't survive for long. Elephants, in contrast, gestate nearly 2 years for a single calf that matures slowly and suckles its mother's milk for several more years.

YOU MIGHT ASK

Do current conditions suggest we go for diversity of options or commit to one well-resolved offer?

What level of commitment can we make to nurture our service or brand after launch?

How might our design fend for itself?

DISTRIBUTED CHOICE

The US Green Building Council redesigned their top-down system for defining yearly initiatives—now they propose and vote on a massive number and allow local priorities and promising ideas to reveal themselves.

Guillemot eggs are shaped to roll in place, not off the cliff...

ADAPTATION

ADAPTATION

Active Form

Geometries in nature have evolved to perform multiple roles and fit superbly their context and purpose.

Bird eggs are shaped for laying, absorbing heat, and protecting the forming chick by resisting external pressure. Marine birds roost on cliff ledges and lay pear-shaped eggs, heavier at one end, that simply rotate in place if they're nudged.

YOU MIGHT ASK

How might we achieve double duty (or more) with a design feature?

How do requirements change over time, through a lifecycle, or customer journey?

MULTIFUNCTIONAL FORM

The Zyliss kitchen whisk has identical wires, each looped separately without crossing at the top. This helps in cleaning, whisking, and in manufacture as there is no need to nest or assemble different loop lengths.

Kingfisher beaks are optimized as multi-media missiles...

ADAPTATION

ADAPTATION

Active Form

Geometries in nature have evolved to perform multiple roles and fit superbly their context and purpose.

The sharp, streamlined shape of the kingfisher's beak is optimized for catching fish. As it dives from the air at speeds up to 25 mph, the unique profile of its beak breaks the water surface without a splash.

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Natural systems can be resilient or efficient, but not both...

ENDURANCE

Efficiency or Resilience

Efficiency is about expending minimal energy. Resilience is about maintaining function despite disturbance; diversity, redundancy and decentralization are key.

Native prairie is resilient: its diverse grasses hydrate the soil at different levels sustaining it through unpredictable conditions. The Yucca moth and Yucca tree have co-evolved to be efficient— the moth lays eggs in the tree's flowers, pollinating them in the process— but without one, the other will die.

YOU MIGHT ASK

Should we assume stable or unpredictable conditions?

Might our system benefit from decentralization, diversity, and redundancy to increase resilience?

FLEXIBLE STRATEGY

A beverage company, anticipating that manufacturing systems will need to cope readily with unpredictable material sources and markets, revised their strategy towards design for resilience, rather than efficiency.

Amid charred remains, pioneer species will find fertile ground …

ENDURANCE

ENDURANCE

Ecological Succession

Following disruption, one type of habitat is steadily replaced by another. Healthy ecosystems often go through cycles of destruction and re-colonization.

Soon after a woodland fire, "pioneer" species begin to grow, first quick-growing grasses and small plants. Fire helps germinate certain tree seeds and, over the decades, pines and eventually hardwood species will grow.

YOU MIGHT ASK

Might changes in the landscape be an opportunity to seed new behaviors or new offers?

How might our launch affect the ecosystem? Which products or services might benefit or suffer?

RENEWED RELEVANCE

As e-commerce and e-readers threaten most local bookstores, one in Cambridge is actually growing its business: by providing printed books-on-demand, events, and services, that engage customers in new ways.

Though rooted, a walking palm can change position in the forest...

ENDURANCE

Dynamic Structure

Nature's forms are able to react, respond, and adapt to local conditions, while retaining their strength and integrity.

The "walking" palm in Latin America, *Socratea exorrhiza*, is able to gradually move from shade towards a sunlit spot by growing new stilt roots in that direction and letting older roots die off.

YOU MIGHT ASK

How might our structure adapt to changing conditions?

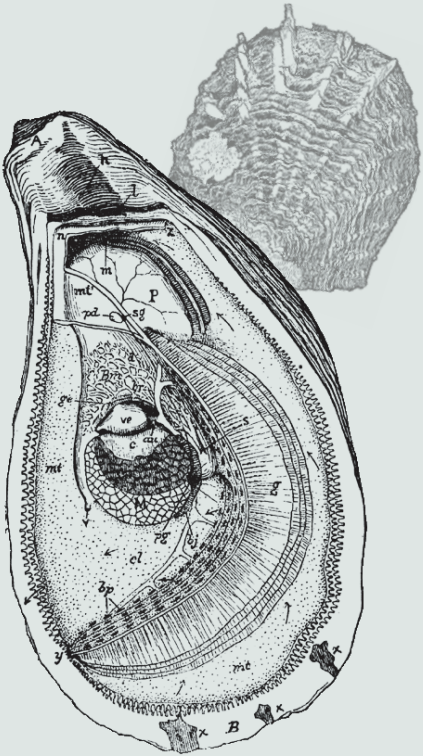
Might we simultaneously stay rooted and move?

AGILE EATS

Food trucks with Twitter accounts allow new epicurean entrepreneurs to succeed in competitive urban markets. Mobile kitchens keep overhead low and readily adapt to local patterns of demand.

The oyster grows its shell by secreting layers of protein and minerals...

ENDURANCE



Living Layers

Natural structures often combine several layers that together provide multiple benefits such as protection from damage and distribution of nutrients.

The oyster shell grows from the inside out as nacre exudes from a thin tissue mantle on the soft body. Inside the shell, the oyster entombs parasites and debris in smooth iridescent layers of new nacre. Outside, the shell is typically rough, conforming to the surface it grew on.

YOU MIGHT ASK

Might layering enhance the experience?

Might we design from the inside out?

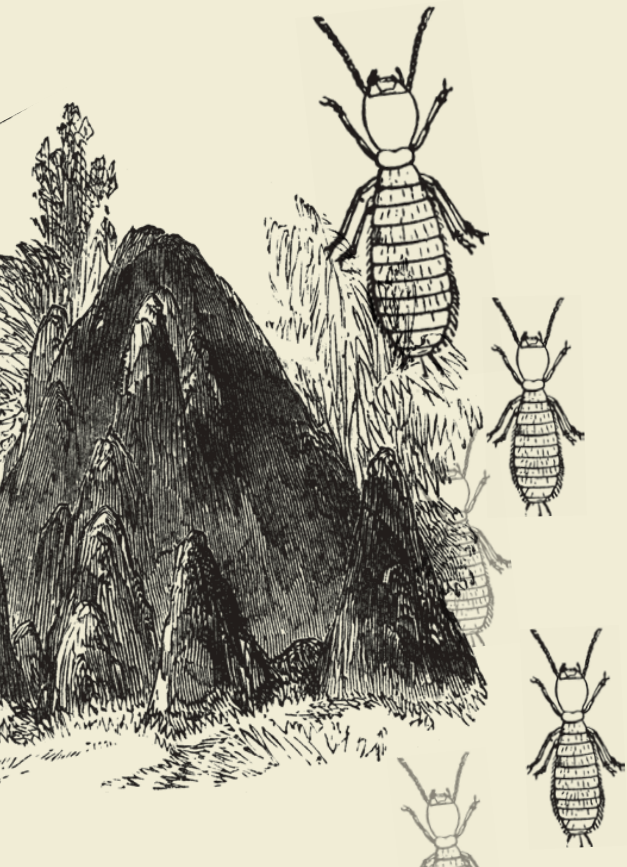
How might our product protect itself?

ELEGANT DELIVERY

Foil pouches for tea bags typically open with a messy tear strip. To provide a more graceful revelation, designers explored self-contained layered structures and color on the pouch interior.

There is no blueprint when a termite colony builds its nest...

COMMUNICATION



Simple Rules

Simple rules allow coordinated action, or "swarm intelligence," to emerge from a community of individuals. The group self-organizes, without top-down control.

Termites are able to build large complex structures in a coordinated way by following a few simple rules: when you sense high CO_2 level, pick up a grain of sand; next, when you sense low CO_2, glue it down.

YOU MIGHT ASK

Are there "simple rules" that could make this community smarter, more coordinated, or communicate more effectively?

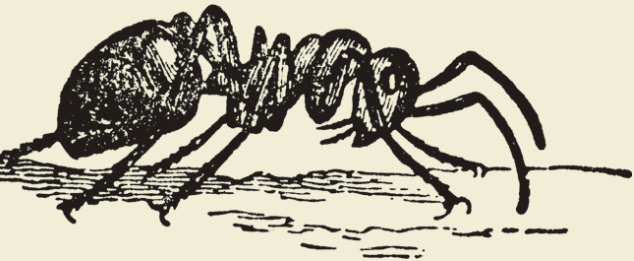
Might we exploit data about interactions within the system?

CONNECTED COMMUNITY

Simple rules connected volunteers in a networked community. Members were assigned two "buddies" in other cities with whom to share information; an emergent communication system spanning the nation.

There's no master plan coordinating the colony's search for food...

COMMUNICATION



Simple Rules

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Ants employ a rule-based strategy for gathering food. Each ant lays down pheromones as it makes its way to food sources, directing other ants there. When a source is depleted, its trail is not refreshed, so ants don't go there. No central control, but intelligent behavior within the colony.

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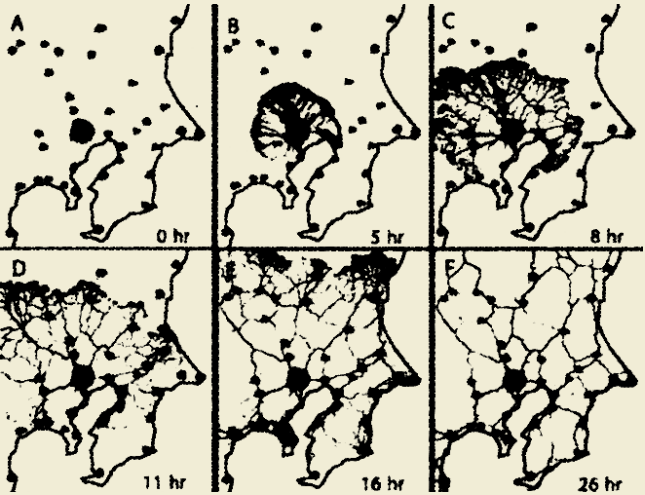
Yellow slime mold is an efficient distribution network for nutrition...

COMMUNICATION



Emergent Networks

Nature's systems for distributing material or information develop over time in response to circumstance, rather than a specific formal plan.

The single-cell slime mold *Physarum polycephalum* grows as a mesh in search of nutrients. Over time, it refines a network of tubes to deliver nutrition to its cell body in the most direct way. With food around the mold in the pattern of the cities around Tokyo, its growth will match the map of the efficient rail system.

YOU MIGHT ASK

What flows and connections might we support in this system or organization?

How might we design effective routes that adapt and reinforce themselves?

OPTIMIZED ROUTING

Toronto-based Regen Energy uses distributed feedback to manage energy networks for systems such as heating and ventilation in large buildings, successfully reducing peak electrical demand.

Meerkat sentries watch out for group safety and raise the alarm...

COMMUNICATION

Contextual Signals

In daily life, organisms tend to communicate and guide behavior through simple signals that derive meaning through context.

Meerkat sentries guard their group, using alarm calls to indicate predator type and urgency. Others in the group then take appropriate action, heading into nearby burrows for aerial attacks, or climbing trees to avoid snakes.

YOU MIGHT ASK

What simple signals might we use to trigger specific behaviors?

What is most relevant to know in this context?

What sensory modes might be most effective?

MEANINGFUL TRIGGER

Every evening at dusk, residents of a Japanese elder community place a small white flag on their porch. If someone notices a missing flag, a staff member will investigate to ensure everything is okay.

Flamingos aren't subtle about whether or not they're in the pink...

COMMUNICATION

Passive Indicators

Information can often be inferred directly from the appearance of an organism.

Flamingos feed on brine shrimp that inhabit their salty lake habitat. Beta carotene in the shrimp result in pink feathers. In the wild, vibrantly pink flamingos signal healthy diet and abundant supply of shrimp; with no shrimp, the flamingos pale.

YOU MIGHT ASK

How might system status or health be communicated automatically?

What are the "brine shrimp" in our system?

PRIORITY GAUGE

For a patient awaiting emergency medical attention, it's helpful to know who might be next in line. At one facility, patients sit in a color-coded section designating their medical urgency and priority in the system.