Sustainable Solutions Workshop

May 20, 2015 Webinar #3

Agenda:

- ✓Intent of Class
- ✓May Homework
- ✓iSite sharing
- ✓Review of biomimicry methodology (scoping)
- ✓Next steps in biomimicry methodology (creating, discovering, and evaluating)
- ✓Two new case studies
- ✓June Homework
- ✓In-person Session Update
- ✓Questions and comments

Identifying Function

1. There are too many plastic drink bottles in our trash; we want a solution that will result in less trash.

3. Xcel Energy wants to build a large solar plant in the San Luis Valley.

4. A river channel built by the Army corps of Engineers is too small and needs to be enlarged.

5. Our school district wants to place recycling bins in local elementary schools.

12. Since the new housing development was built, we need another wastewater treatment plant.

13. Our county wants to recycle building materials from houses that are to be demolished.

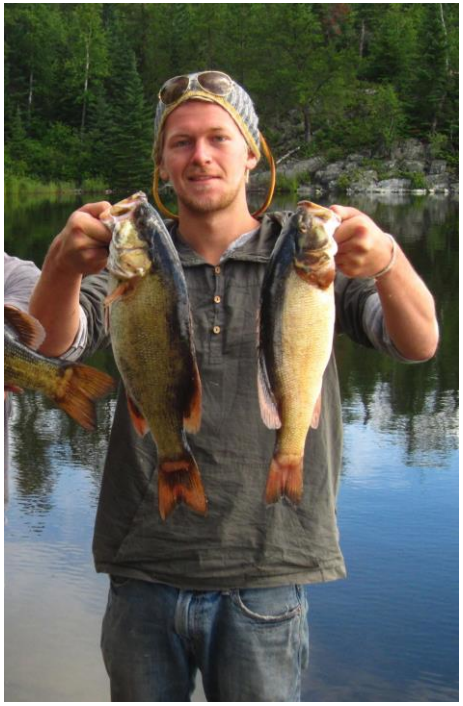
14. I want to bring people in my community closer to Nature.

15. Flower spread their DNA via seed dispersal.

Climate Change and Seasonal Adaptations Team

Eliot Kersgaard

CU Physics Student
CU Biomimicry Club President
Hobbies: Growing my own food
Passion: Creating a more seamless interface between humans and our environment



Jonathan Fenton

CU Environmental Design Student
Hobbies: gardening, fishing, sketching, design
Interests: mycology, living buildings

Eliot Kersgaard

Scoping Function and Challenge: Climate Change Team

Jonathan Fenton

Functions:

1. Adapting to changing water resources
    a. Growing Food
    b. Drinking Water
    c. Sanitation
    d. Livestock
2. Adapting to desertification (changing environment)
    a. Protecting boundaries
    b. Protecting soils
3. Preserving livelihoods
4. Balancing cultural needs with environmental limitations

Context:

Tribal, local, state, and federal governments

Maintenance/adaptation of cultural values, livelihood, and economic viability

Consideration of internal and external interests

Local scope- genius of place

Variations in population density

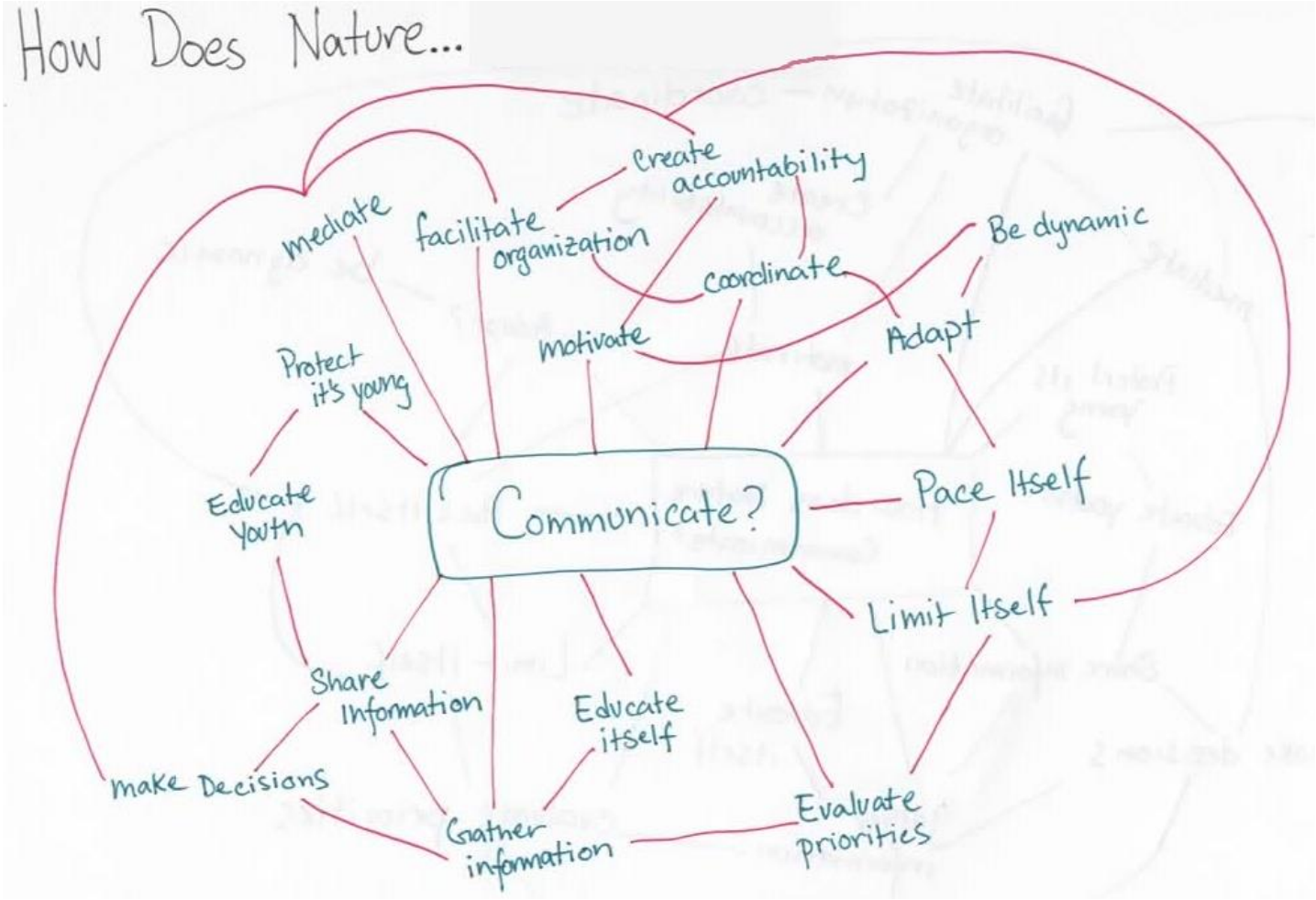
Preservation of bison

Team Climate Change:
Eliot Kersgaard, Jonathan Fenton, Ina Nez Perce, Sean Chandler, Liz McClain, Jim Evanoff

Team Communication

HW Assignment #2
May 2015

What are the Functions we want to achieve in our challenge?



Team Communicate: Martin Ogle, Jayne Michaud, Lynn Chan, Kendra Krueger, Kate Gregory, Tim Davis

Context for Team Challenge

- A group of individuals engaging with a challenge to find a solution.
  - A group like us!
    - How to communicate
    - How to organize
    - How to create accountability
    - How to be creative, dynamic + resilient
- Educating children
  - How to Share information and wisdom
  - How does playing, learning and chaos come together
  - How to teach accountability
  - How to teach creativity and resiliency
  - How to teach good communication

Things to consider:
What are the conditions?
What are the circumstances?
What are the constraints?
Who is the end user?
What supply and distribution systems are necessary?
What is the budget?
What kind of space and time are available or required?

Team Communicate: Martin Ogle, Jayne Michaud, Lynn Chan, Kendra Krueger, Kate Gregory, Tim Davis

Team Lifeblood

Peter Criscione – Denver, CO

Energy efficiency technology and strategy analyst; electrical and mechanical components design and troubleshooting; electrical engineer; campaign strategist; Tom Brown Jr. Standard Class on nature observation and tracking; hobbies: hiking, camping, edible plant identification, animal tracking, primitive living skills, archaeology, genealogy.

Wendy Weaver – Bozeman, MT

Mom, endurance runner, LEED accredited professional, licensed professional civil engineer, board member of City of Bozeman Mayor's Climate Action Task force and helped develop the "Idle Free Bozeman" Initiative; developed first Green School challenge in Montana; professional mentor for Engineers Without Borders at MSU in Kenya.

Team Lifeblood (Water):
Peter Criscione, Wendy Weaver, Craig Stevenson, Mike Montoya, Laurel Dygowski, Greg Davis

Disturbandits

Challenge:

- How does nature manage disturbance?

Function:

- Nature's resilience despite human destruction/alteration of natural ecosystems.
- Rectifying negative human interaction to allow nature to regain balance more swiftly.

Disturbandits Team: Raina Turner, Emilie Lang, Tom Quinn, Matt Pfeiffer, Ted Thayer

DISTURBANCE

Disturbandits Team: Raina Turner, Emilie Lang, Tom Quinn, Matt Pfeiffer, Ted Thayer

iSite

(Re)connecting with Nature = actually being in Nature

iSite Sharing

Monarda - Bee balm

Alyssum saxitile Basket of gold

Phlox

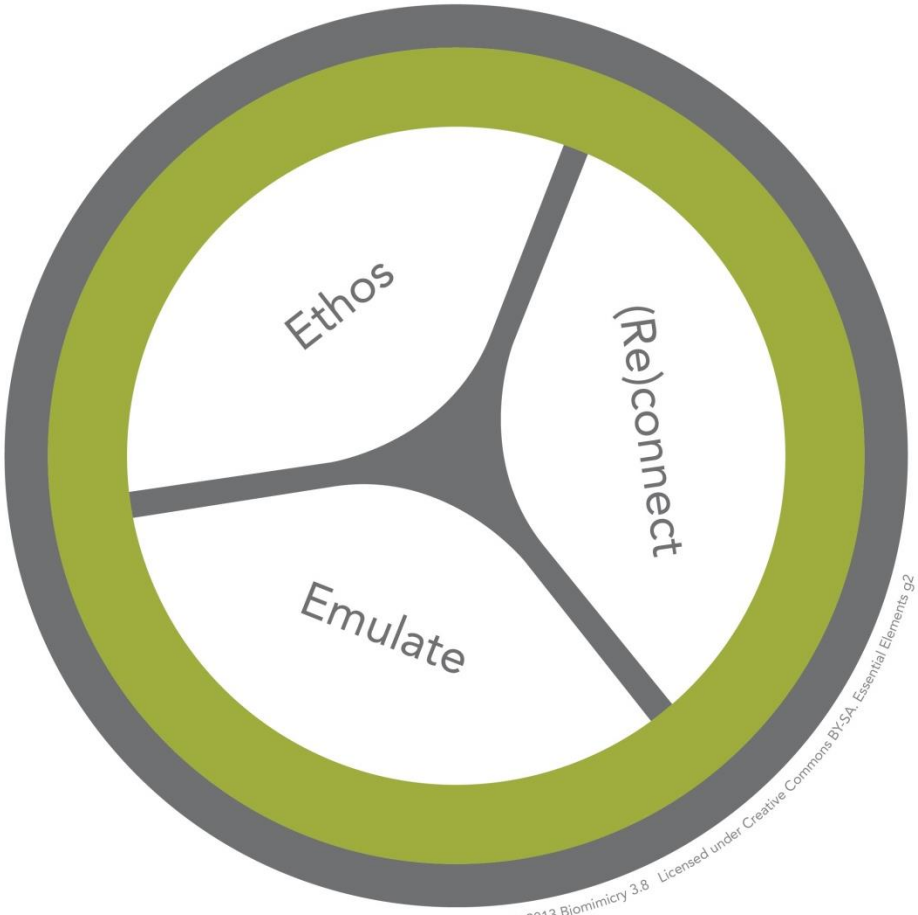
Thyme

Achillea millifolium - Yarrow

Stachys byzantina - Lamb's ears

Dandelion

Essential Elements of Biomimicry



Integrating Biology into Design

Emulate Nature

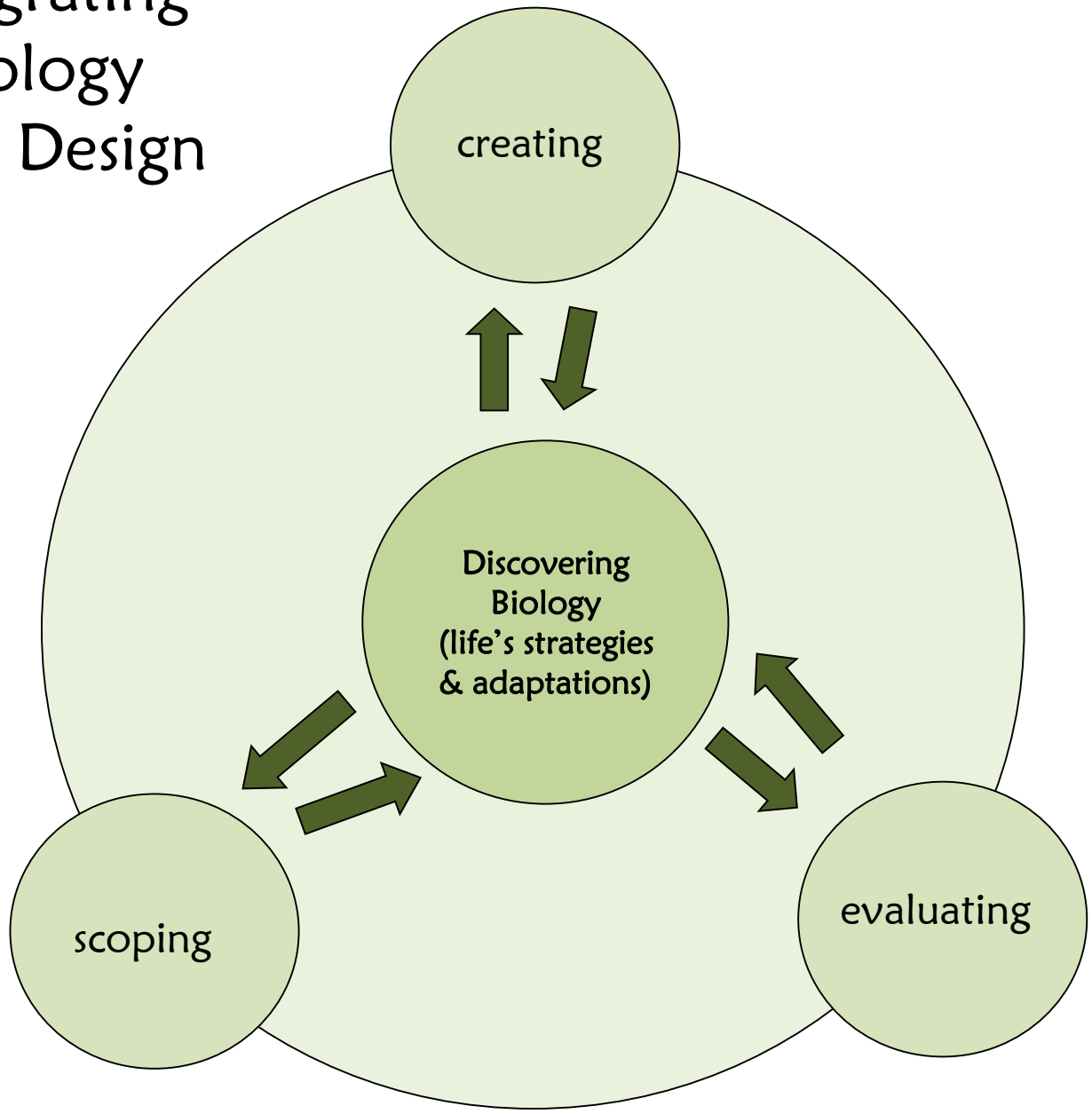
Scoping

Discovering biological strategies

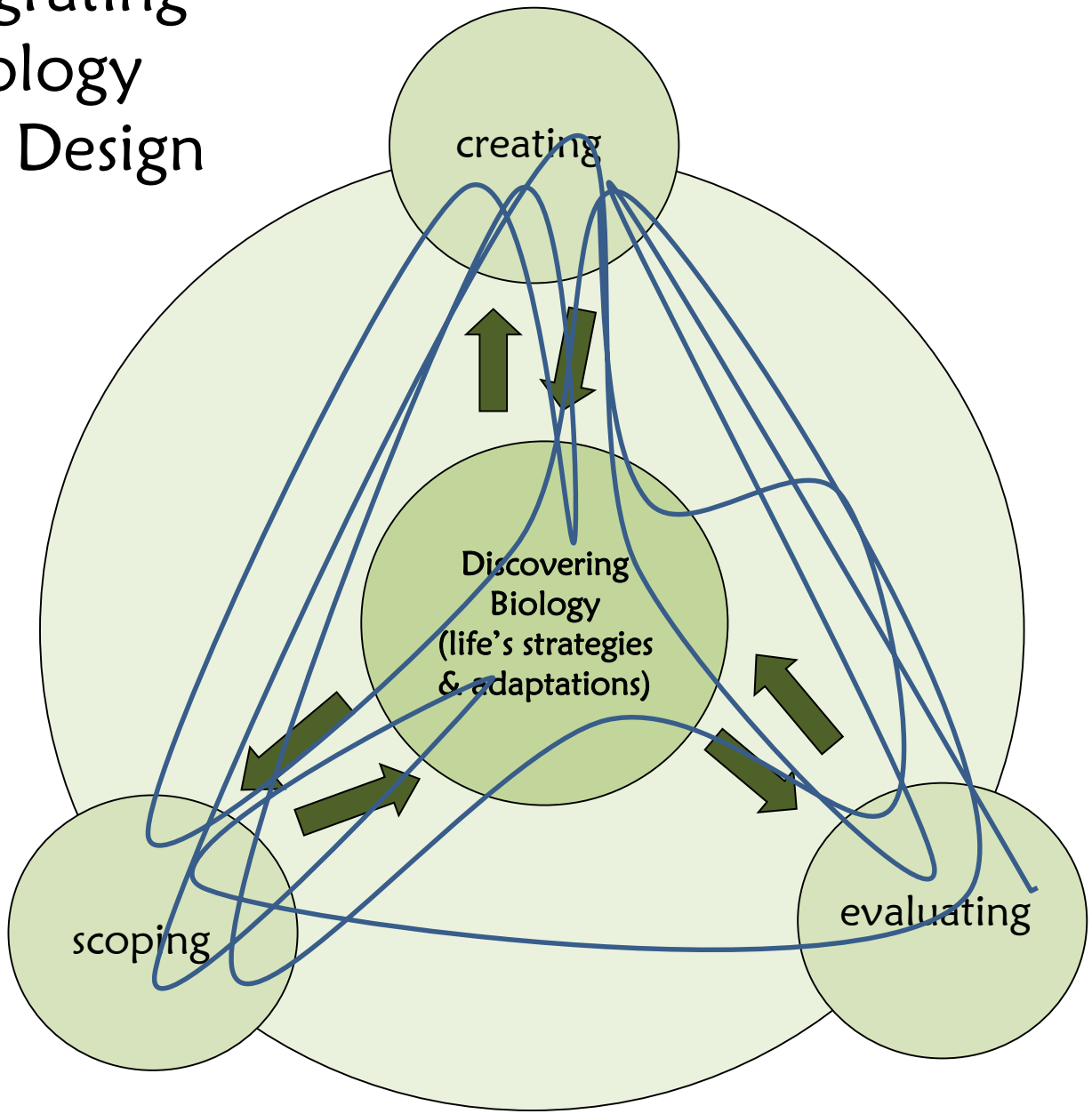
Creating

Evaluating

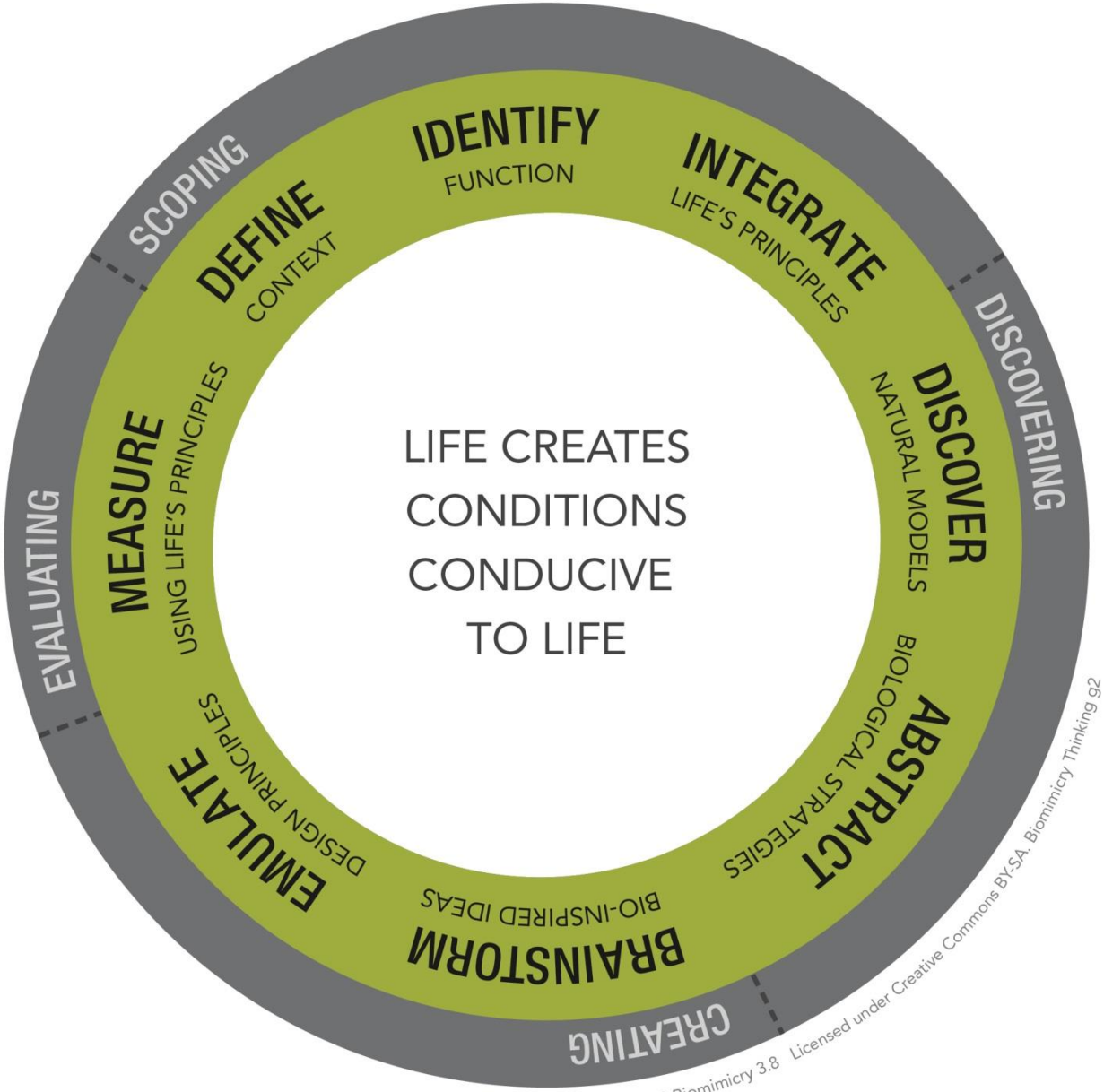
Integrating Biology into Design



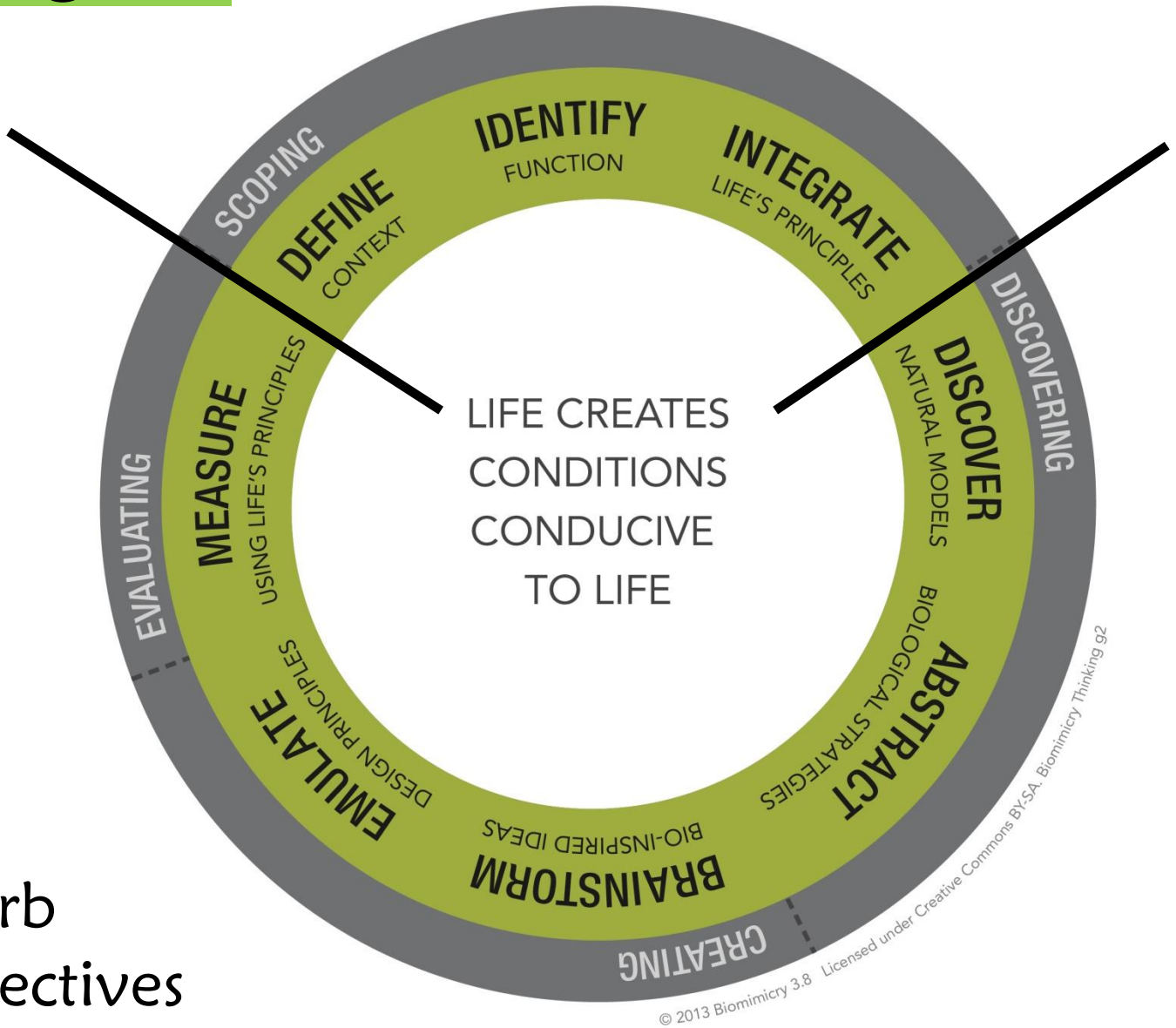
Integrating Biology into Design



Design Process



Scoping



What would
Nature do…?

Function = verb
Context = adjectives

Scoping

Biologize:

Take a human need or function and rephrase it so that an answer may be found in biology.

Water in short supply/water conservation plan → Conserve water? Maintain moisture?

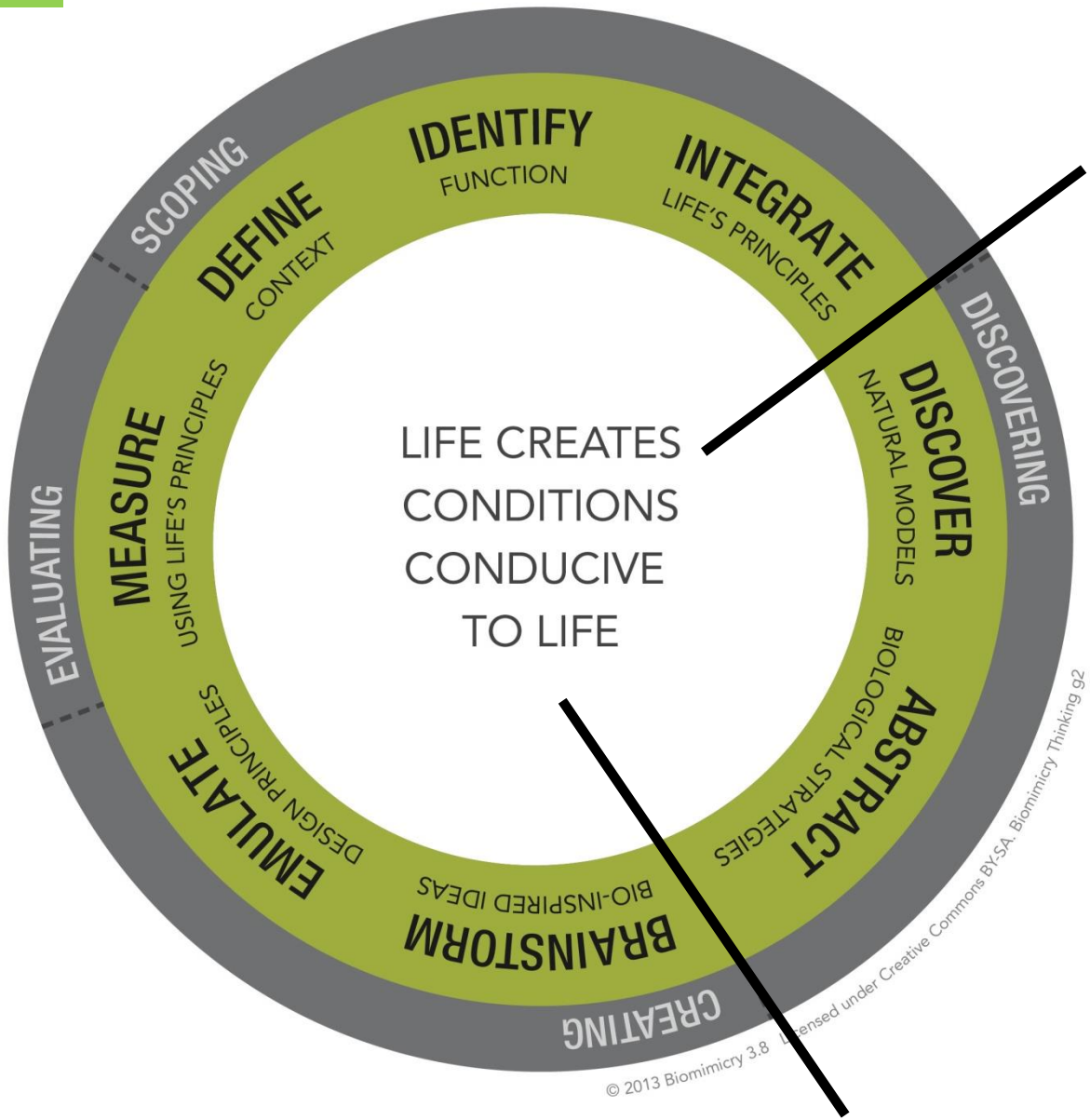
Water availability varies/Water storage → Build flexible yet strong containers?

organisms and ecosystems face the same challenges that we humans do

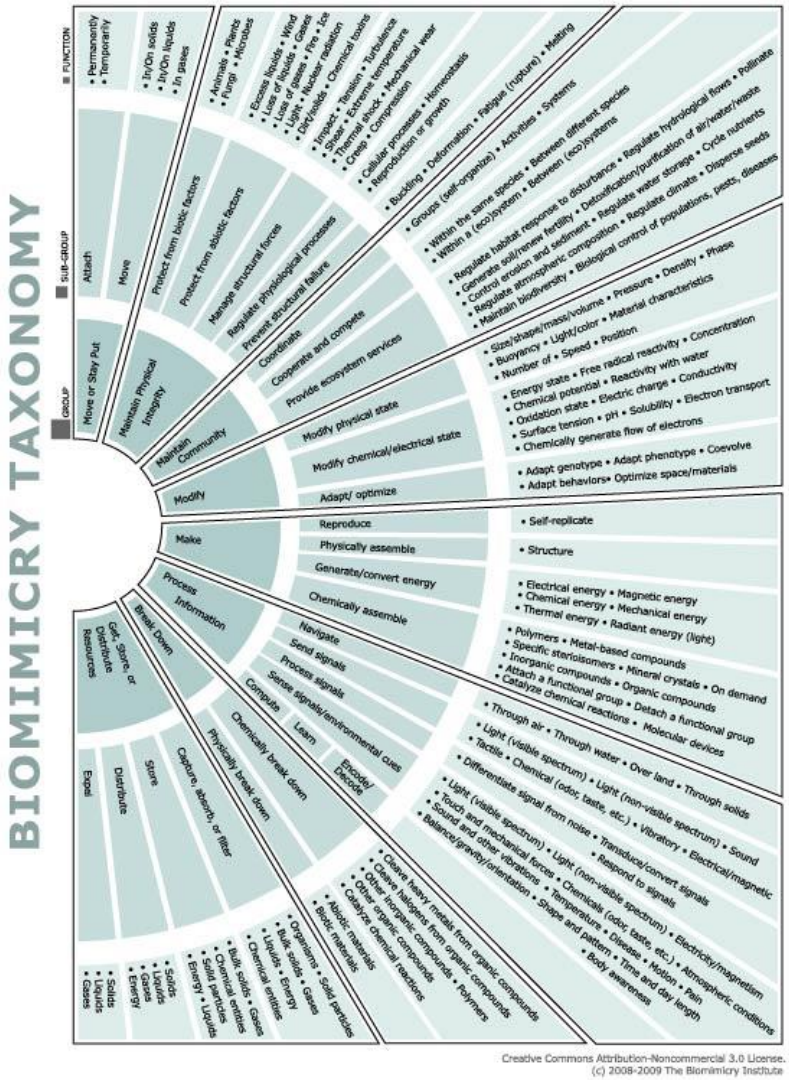
The Genius of the Congo

Discovering

Discover Natural models



Biomimicry Taxonomy



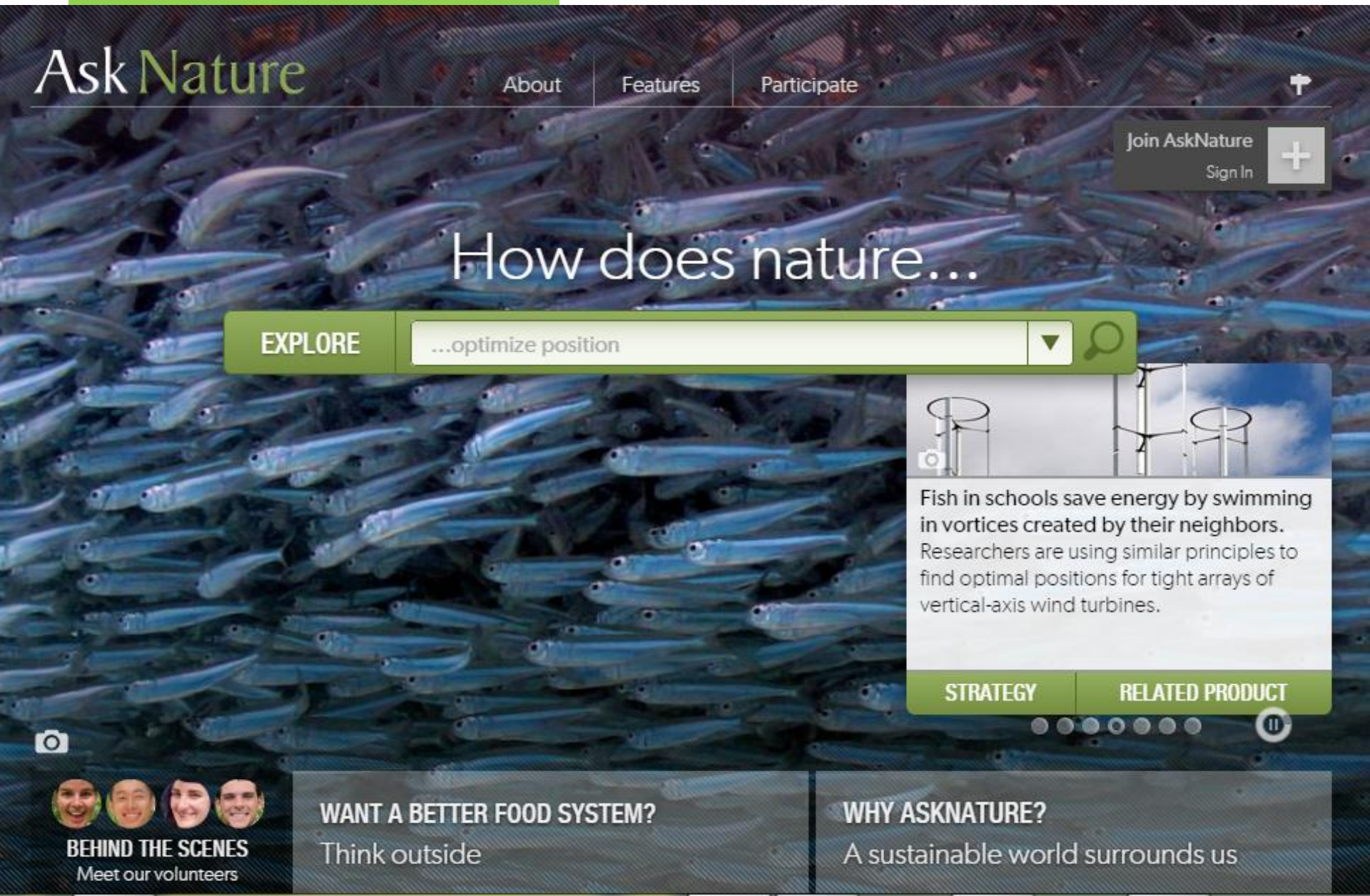
The biomimicry taxonomy can be a useful tool in thinking about function.

It is a comprehensive look at the functions of life.

Discovering

- What do you already know?
- Go outside and observe
- Google/google scholar
- Literature searches
- Research articles
- Ask experts – colleges, universities, etc.

Discovering



Discovering

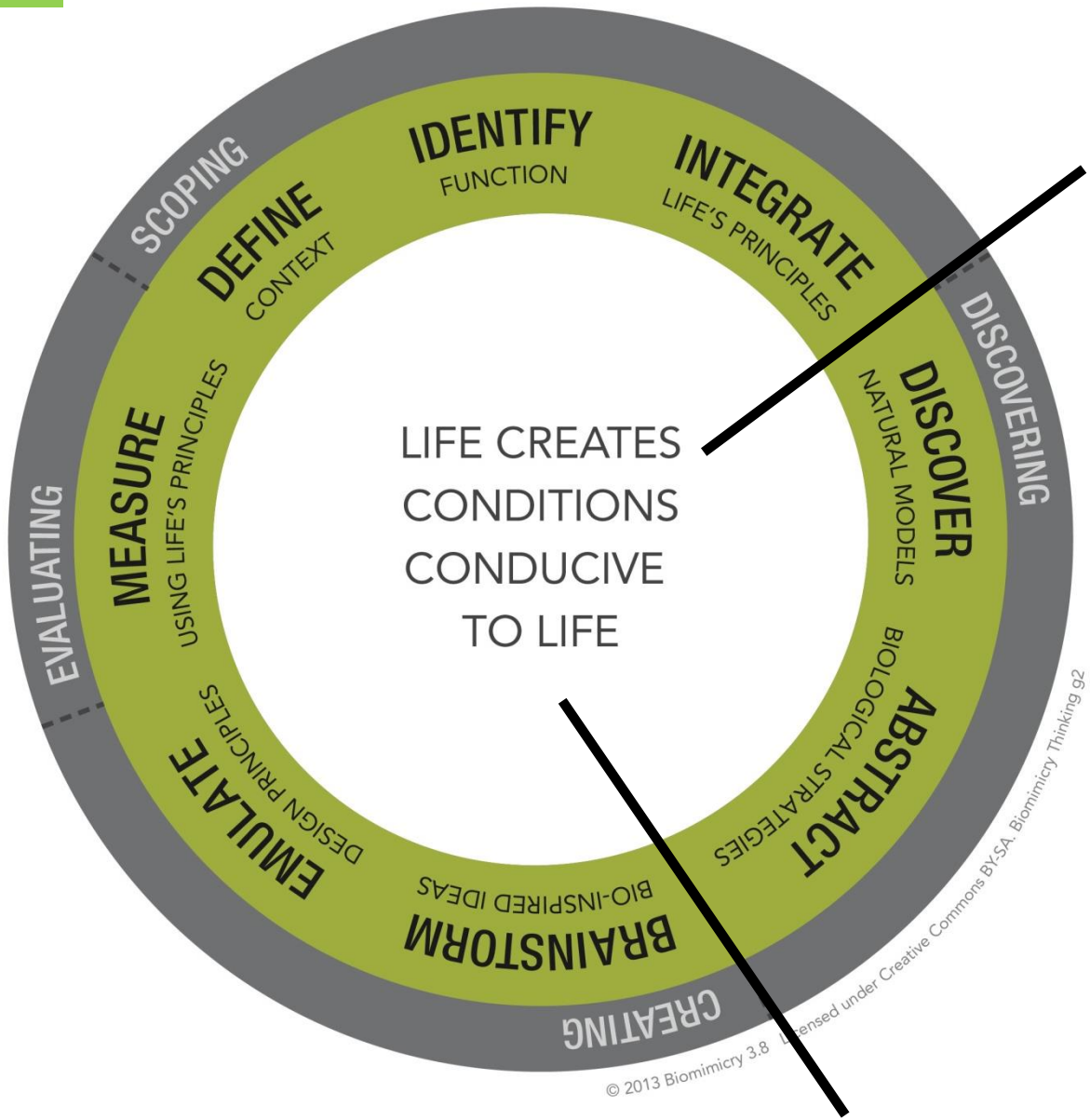
A	B	C	D	E	H	I	J
	OPERATING CONDITION		TEAM	ORGANISM	MECHANISM	SOURCE (1)	SOURCE (2)
4	Flooding & Standing Water Conditions	1	Estelle	African Pike	By attaching to an air bubble with a cement gland in their head, the larvae are able to grow in an oxygen rich environment at the air/water interphase during a seasonal time of low oxygen concentration in the water.	Alternative life-history styles of fishes (1990). The reproductive biology and early development of the African pike, Hepsetus odoe, in the Okavango Delta, Botswana. Merron, G.S., Holden KK and Bruton MN.	Acta Zoologica. 2000. Observations on the structure of larval attachment organs in three species of gymnotiforms (Teleostei: Ostariophysi). Britz, R., Kirschbaum, F and Heyd A.
		2	Diana	Raffia Palm	Raphia palms are widespread, thriving in "Raphia swamps"; "Raphia's success is based on simple rules of allometric construction and the ability of a vascular system to function indefinitely without replacement. Perhaps the most distinctive property of palm stems is the ability of mature differentiated stem cells to retain their viability for centuries."	Oryx, Flora and Fauna International, 2009, Volume 44, Issue 1, pp. 124-132. Survey of Raphia swamp forest, Republic of Congo indicates high densities of Critically Endangered western lowland gorillas Gorilla gorilla gorilla. Rainey, H. J., F. C. Iyenguet, G-A.F. Malanda, B. Madzoke, D. Dos Santos, E. J. Stokes, F. Maisels, and S. Stirndberg.	Botanical Journal of the Linnean Society, 2005, Volume 151, pp. 5-14. The uniqueness of palms. Tomlinson, P.B.
		3	Peggy	Fish (gen behavior due to ecology)	Taking advantage of flooding cycles, fish of African rainforests are able to access different habitat seasonally; high water levels minimize exposure of eggs to hypoxia characterizing the dry seasons	Chapman LJ 2001_African Rain Forest Ecology and Conservation: An Interdisciplinary Perspective, ch 16 Fishes of African Rain Forests: Diverse Adaptations to Environmental challenges	
		4	Peggy	Kapok Tree	Buttressed roots are effective structural members supporting large trees on substrates that offer poor anchorage. They are thought to develop in response to the overturning moment associated with an unbalanced crown as well as to reduce tension forces from uneven canopies or eccentric loading or soil conditions and thus the stiffness and effective diameter at the base of the tree	Henwood 1973 A Structural Model of Forces in Buttressed Tropical Rain Forest Trees. Biotropica Vol. 5, No. 2 (Sep., 1973), pp. 83-93, Published by: The Association for Tropical Biology and Conservation. Article Stable URL:	

Discovering

Discover Natural models

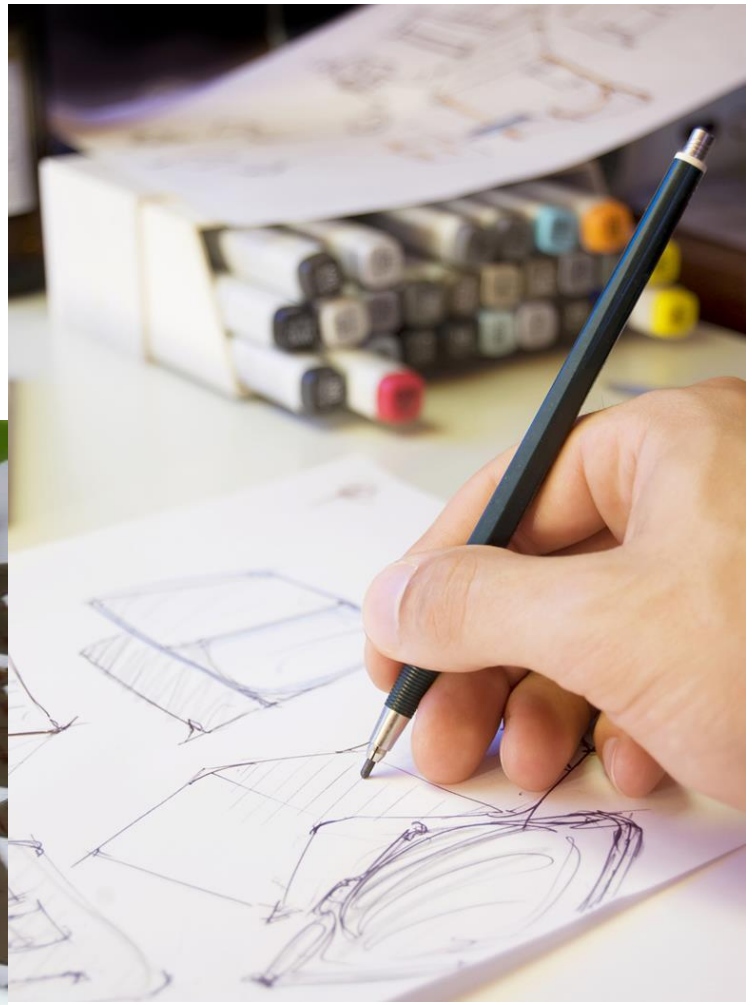
Abstract Biological Strategies

Translate from biology – abstract the Design Principles



Integrating Biology into Design

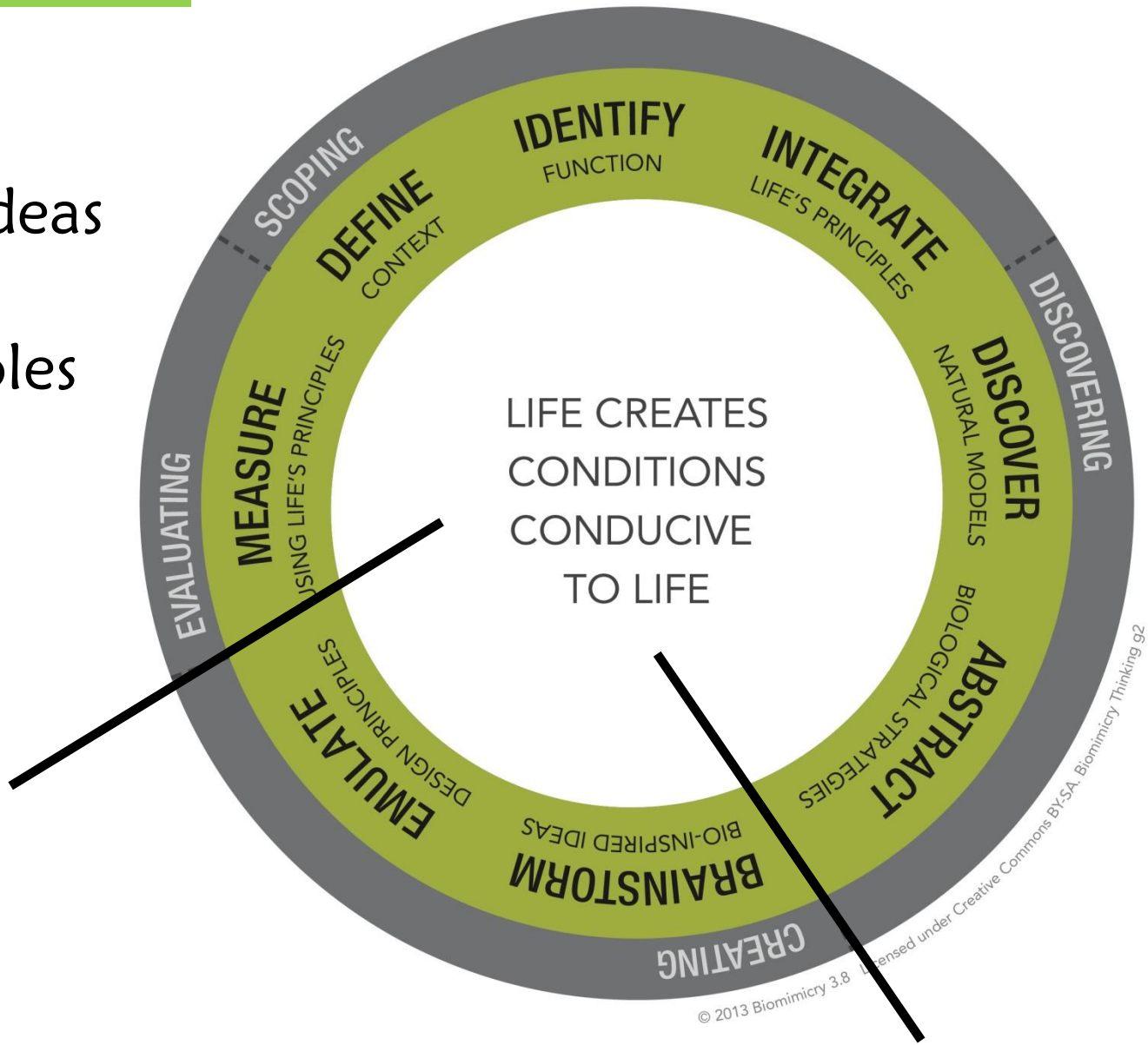
Emulate: incorporating biology into a design

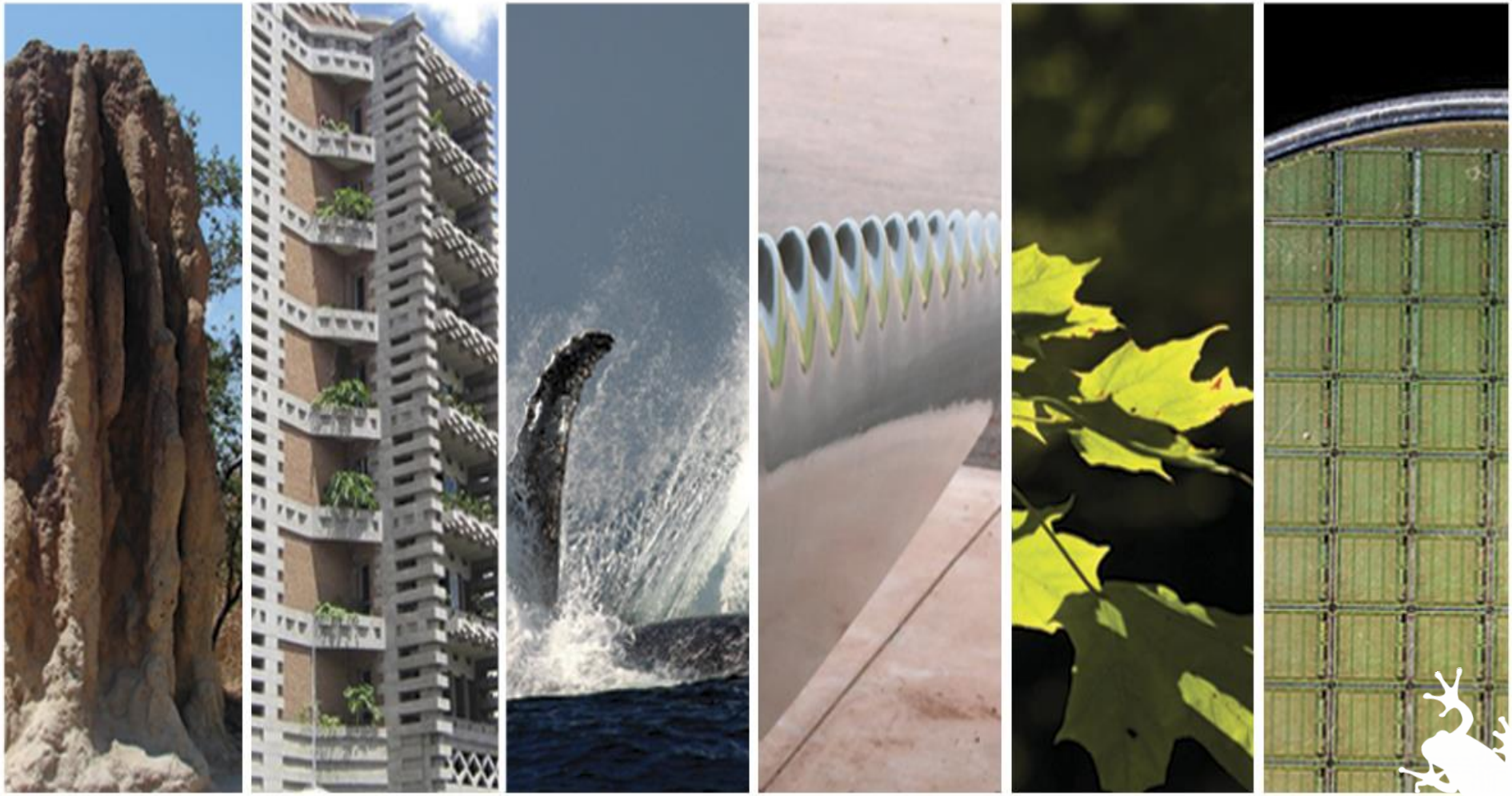


Creating

Brainstorm
bio-inspired ideas

Design Principles





the conscious emulation of nature's genius

HOW DOES NATURE COLLECT WATER?

OPERATING CONDITION

CONSTANT WARM TEMPERATURE

Anisoptera

REGULATE RADIANT HEAT

MECHANISM

Dragonflies have a triad of dry, moist, and cold neuron receptors that allow for temperature perception at a micro-climate scale.

DRAGONFLIES

KEY LIFE'S PRINCIPLES

- ❖ Be Locally Attuned and Responsive
  - Use Feedback Loops
- ❖ Be Resource Efficient (Material and Energy)
  - Use Low Energy Processes

BIOMIMICRY TAXONOMY

- ➢ Modify
  - Adapt/Optimize
    - Adapt Behavior

DESIGN PRINCIPLE

Maintain a constant temperature regardless of the ambient temperature through dynamic orientation to a heat source in order to adjust the amount of radiant heat absorbed.

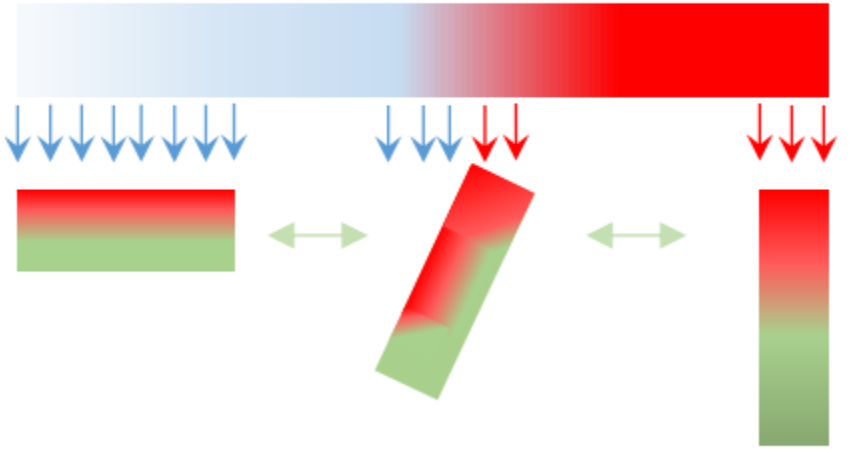


Fig. Maintain a constant temperature through dynamic orientation to heat source

APPLICATION IDEAS

A. Micro-thermoregulation designed in such a way that individual micro-climates can be established based on user preferences in cars, home and office environments.

B. Using soft micro-sprays for cooling.

C. Using light-sensitive glass in buildings to allow less light through during the warmest part of the day and allow more light through in low-light conditions.

D. Midday siesta time – to limit activities during extreme heat.

E. Dynamically orient skylights to let more or less heat into a building.

Fig. Create micro-climates in office environments based on individual preferences

OPERATING CONDITION

HIGH RAINFALL WITH DRY PERIOD

DIFFERENTIATE TO NICHE

MECHANISM

System increases species diversity by providing multiple niches for differentiation within a complex vertical architecture with minimal limitations to growth.

HIGH SPECIES DIVERSITY

KEY LIFE'S PRINCIPLES

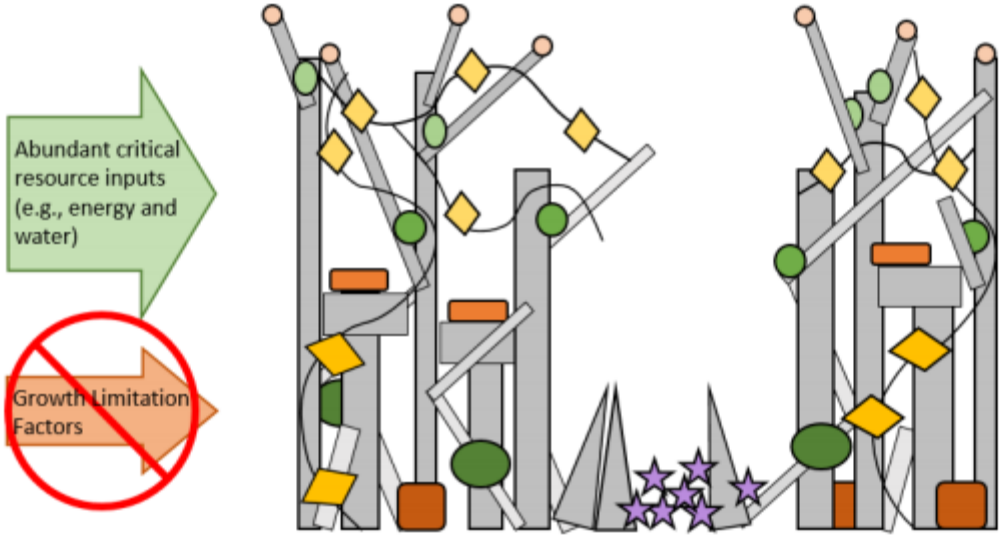
- ❖ Adapt to Changing Conditions
  - Incorporate Diversity
  - Embody resilience through variation, redundancy and decentralization
- ❖ Be Locally Attuned and Responsive
  - Use readily available materials and energy
- ❖ Evolve to Survive
  - Integrate the unexpected
  - Reshuffle information

BIOMIMICRY TAXONOMY

- Maintain community
  - Cooperate and compete
    - W/in an ecosystem

DESIGN PRINCIPLE

Increase diversity in a system by providing multiple niches for differentiation within a complex system architecture while providing minimal limitations to growth.



APPLICATION IDEAS

A. Planning for urban agriculture in a city - allowing for agriculture on the ground, rooftops, food forests, vertical farming, walls, etc. and providing resources to do so (e.g., water infrastructure, job training programs, start-up funding)

B. Urban planning - provide multiple types of living/business/shared spaces at varying costs (free on up), sizes, locations, etc.

C. Vertical/integrated farming within the forest structure

D. Creating opportunities within a business for employees to develop a niche specialization and allowing them freedom with adequate resources to grow that niche

E. Education platform that teaches to the interests and capability of students at the student's pace (e.g., Montessori)

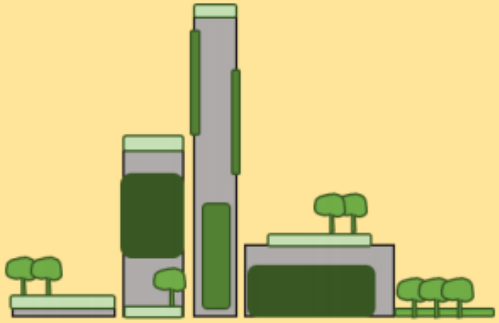
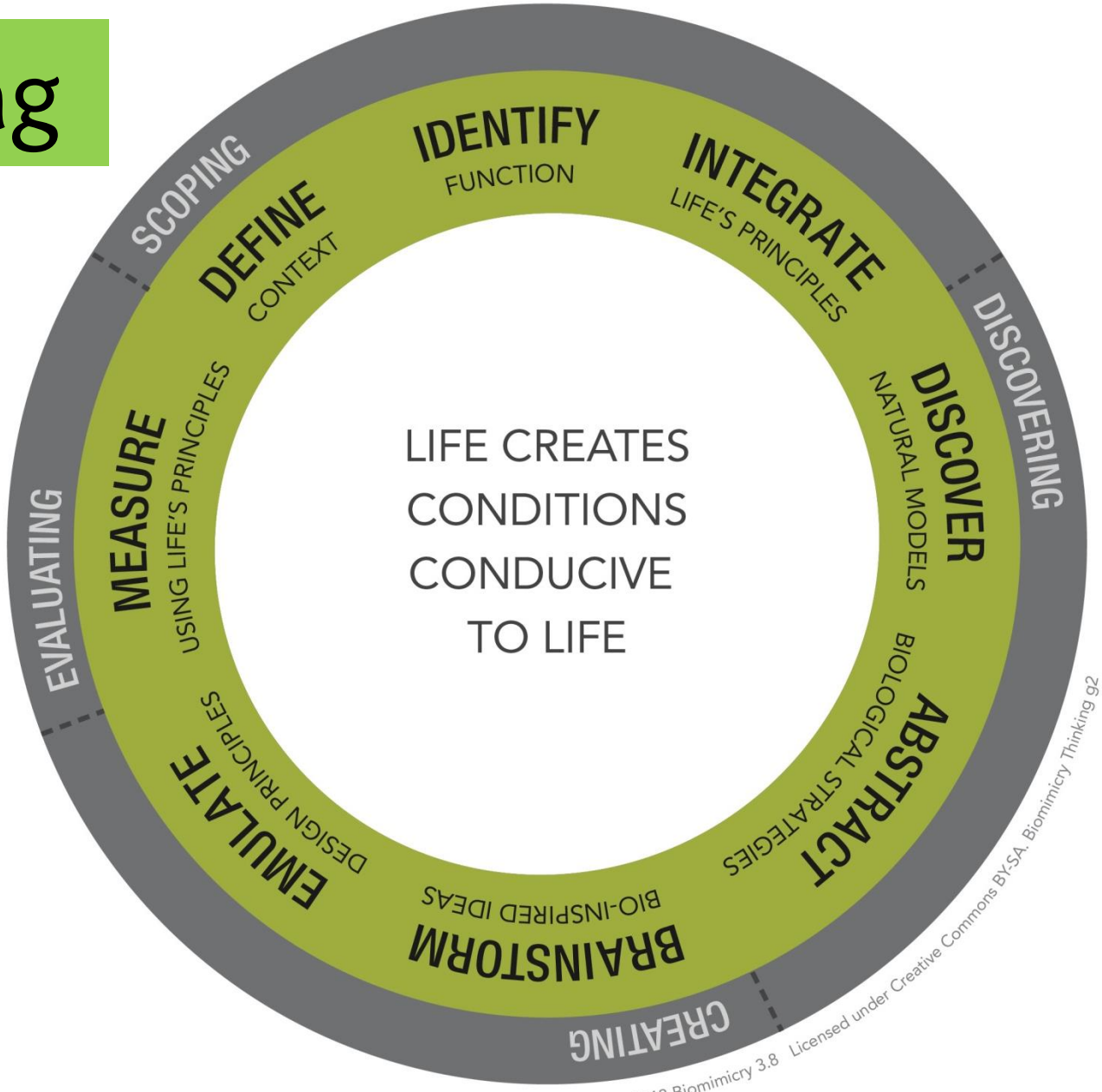


Fig Urban agricultural niches at different levels within a city.

Evaluating



Evaluating

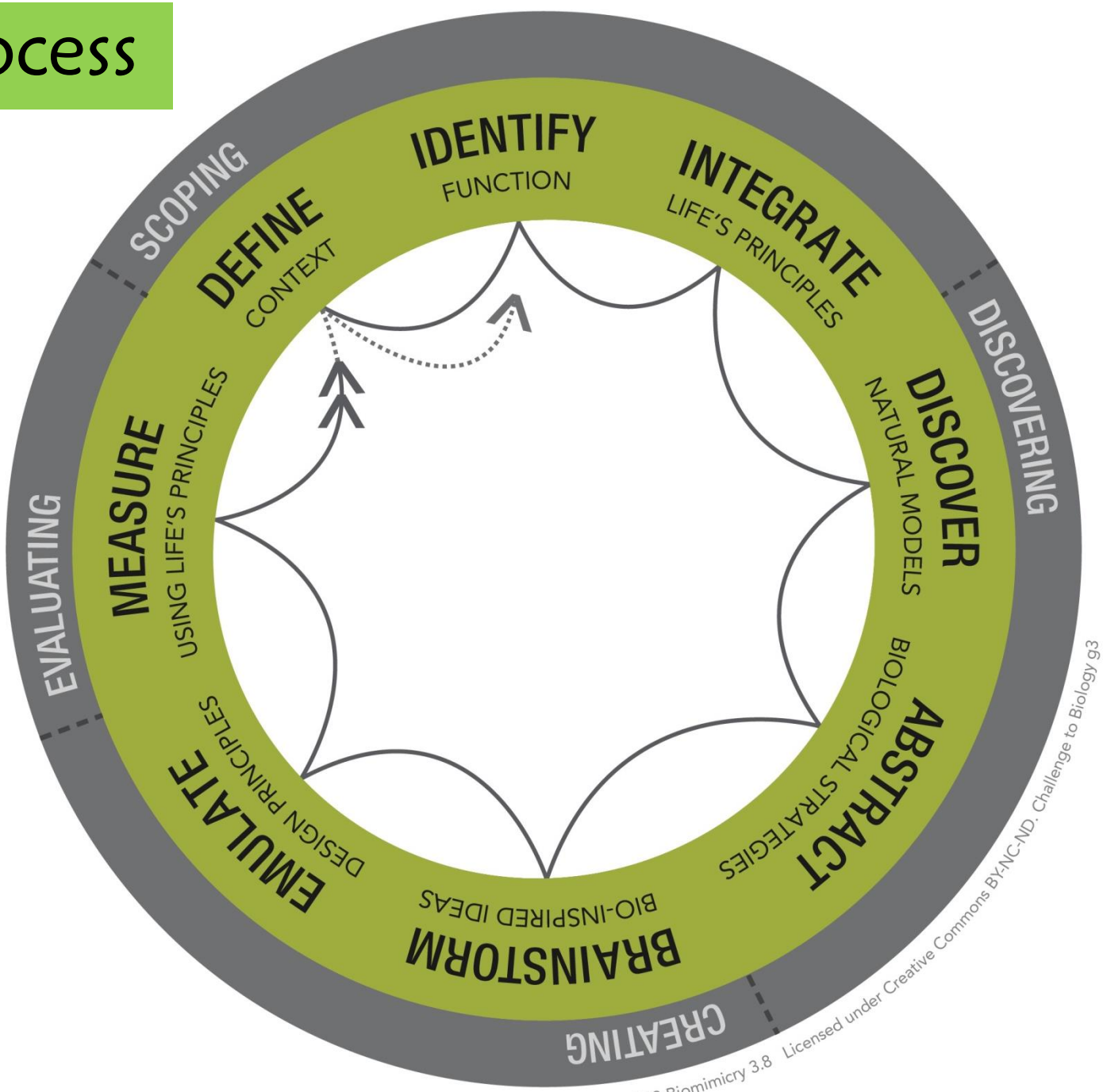
- Evaluating using biomimicry is an innovative way for humans to critique their project's appropriateness.
- Evaluations with Nature as the measure provide higher standards than conventional measuring tools – since they are based on natural models

Evaluating

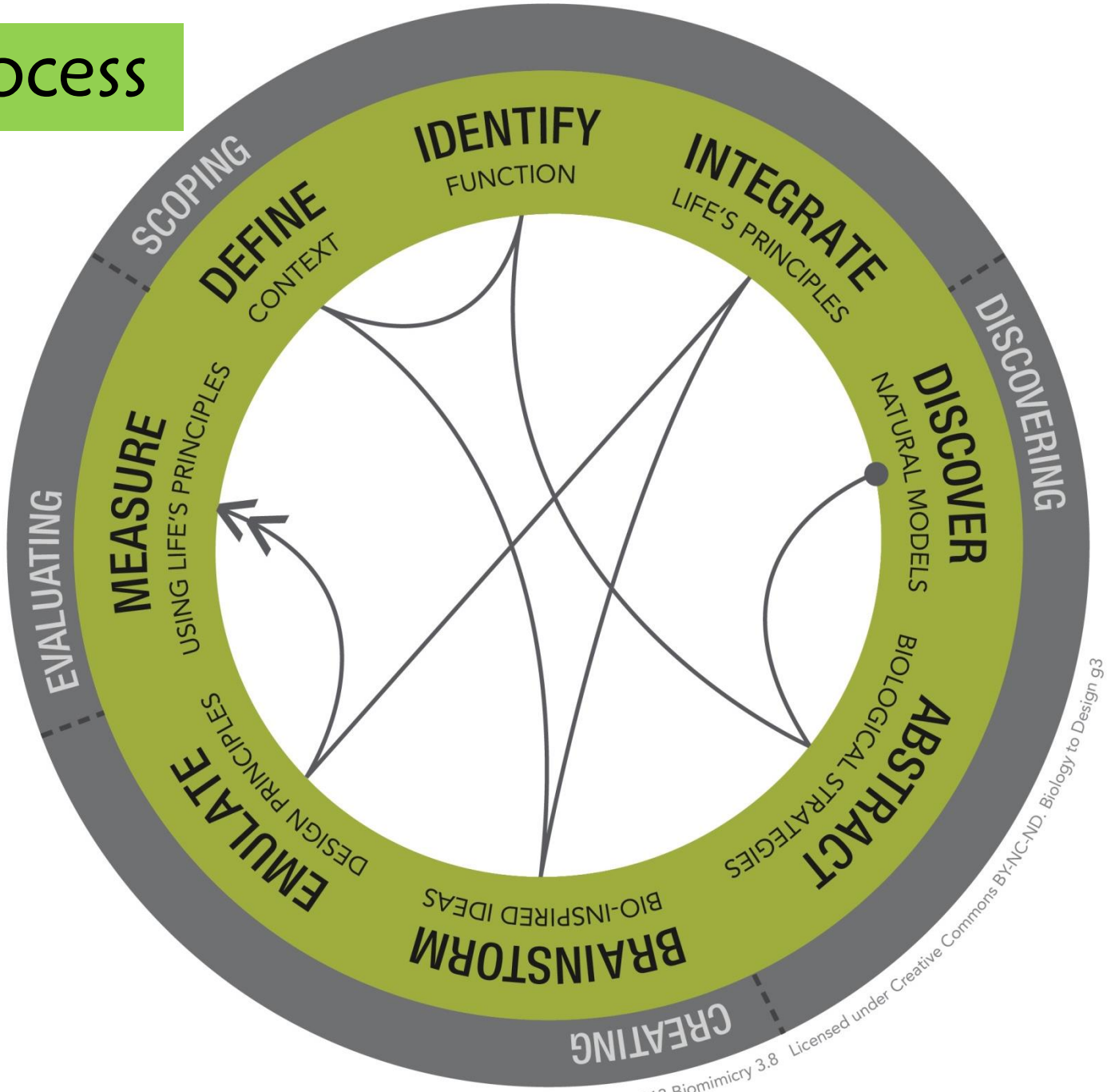
EPA Region 8 Building, Denver

Gold LEED Certified

Design Process



Design Process

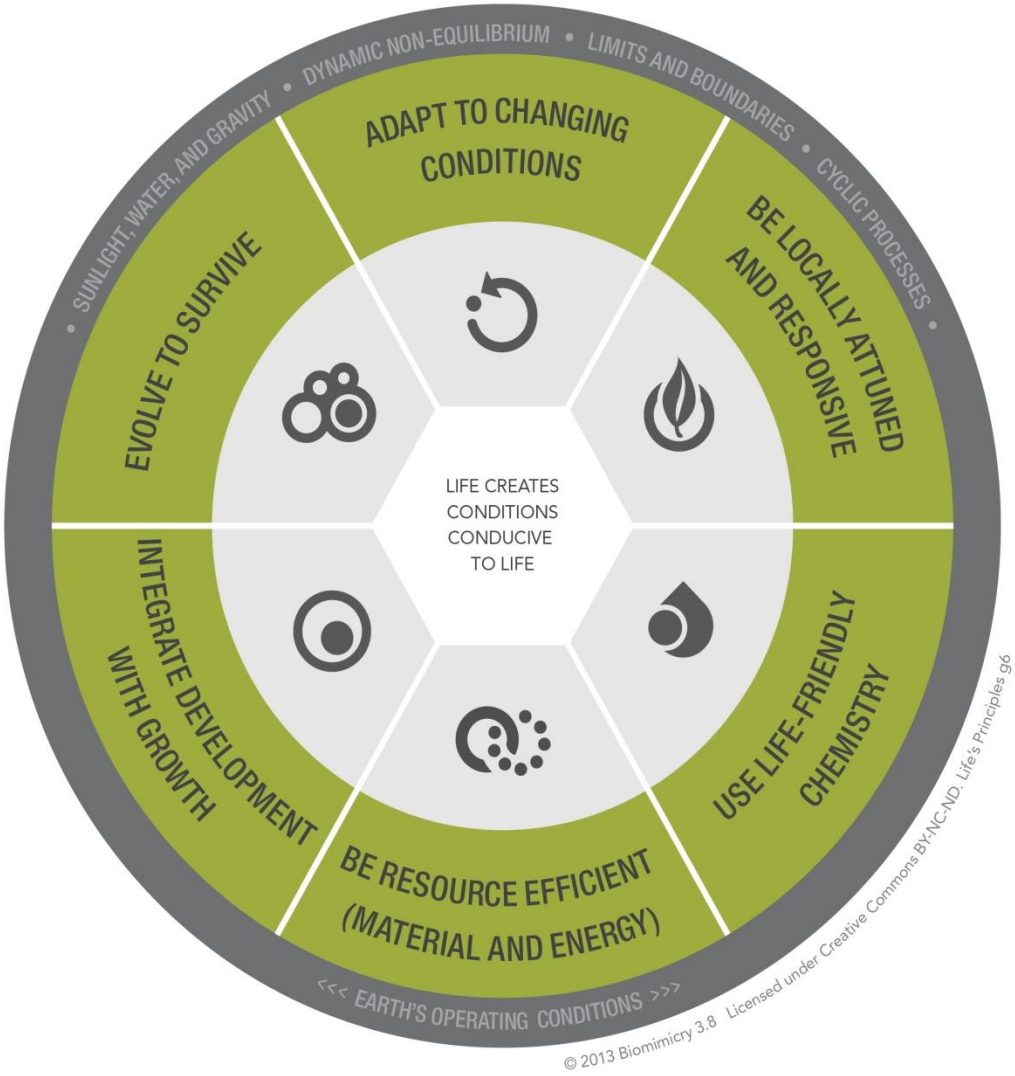


Evaluating

Life's Principles

"*After 3.8 billion years of evolution, nature has learned what works, what is appropriate, and what lasts here on earth."*

Janine Benyus



Life's Principles Checklist

- ❑ Evolve to survive
- ❑ Be resource (material and energy) efficient
- ❑ Adapt to changing conditions
- ❑ Integrate development and growth
- ❑ Be locally attuned and responsive
- ❑ Use life-friendly chemistry

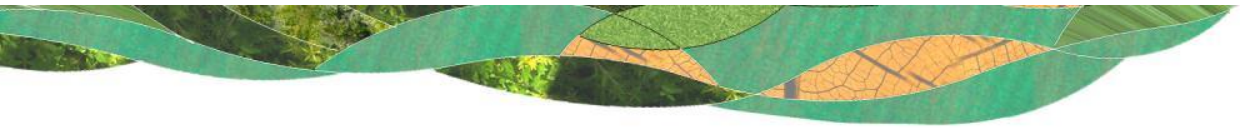

Baleen Filters
resource recovery recycle re-use

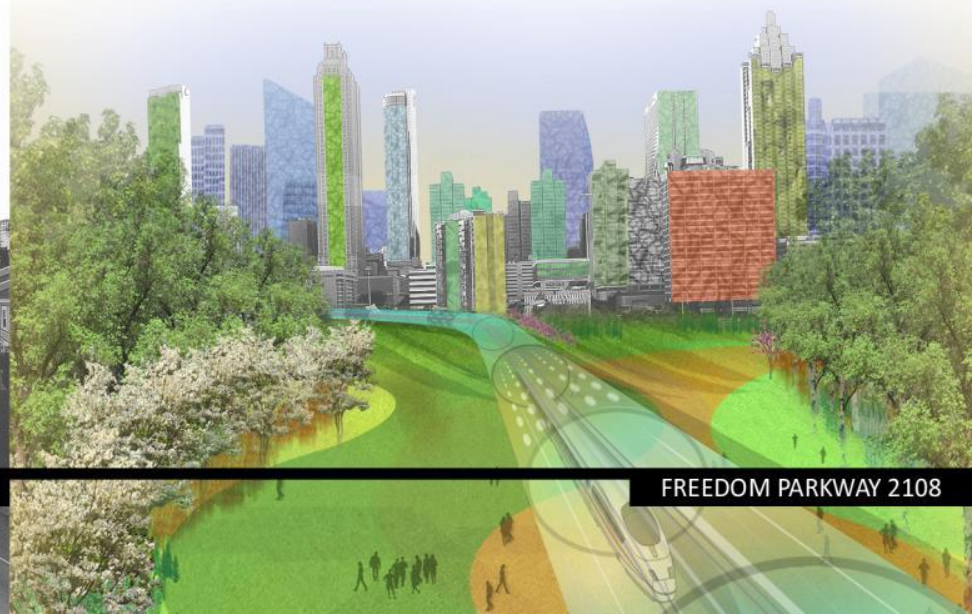
Arnold Glass
Ornilux.com

How does Nature avoid a collision?

How would Nature design a city?

Atlanta: City of the Future Competition





In-Person Session – Livingston, MT
August 9 – 13, 2015

June Homework
due June 14, 2015

- **Challenge to Biology Worksheet**
  - You've started the scoping, proceed with discovering, creating, evaluating
- **Tell a story - write a paragraph** of the process so far and have a team member present to the group during the June webinar
- **Check out** www.AskNature.org
- Continue your **iSite practice**
- Watch this 4 minute YouTube video **"Evolution of the Butterfly"** https://www.youtube.com/watch?v=gcacx_i6MIE
- **Go outside and be inspired!**

THANK YOU! THANKS, NATURE!

OUR NEXT WEBINAR IS WEDNESDAY, JUNE 17, 2015