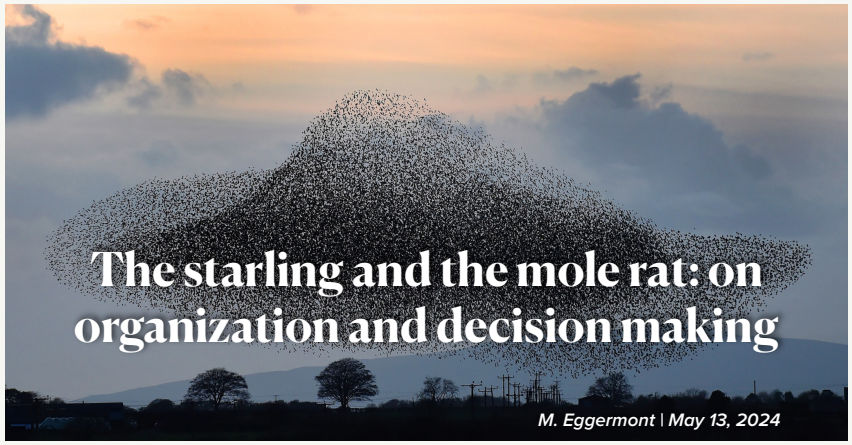


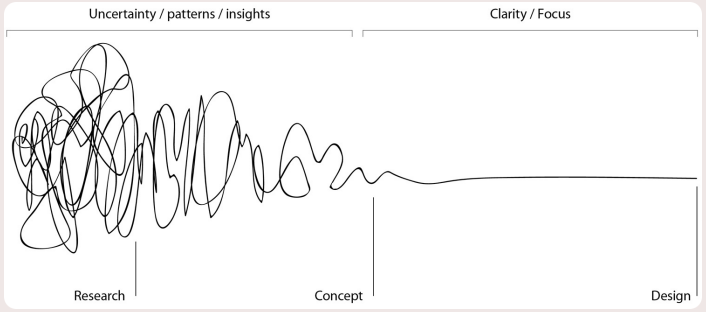
About me

- Teaching Professor (Mechanical and Manufacturing Engineering)
- Associate Dean Sustainability, Schulich School of Engineering, UCalgary
- Co-director, United Nations University Water Hub @ UCalgary
- Academic co-lead, Democracy, Justice, and Sustainability, Institute for Transdisciplinary Scholarship, UCalgary
- Designer/Publisher/Co-editor of ZQ (Zygote Quarterly) - an online bio-inspired design journal (zqjournal.org)
- Background in military history, art, design, biology, computer science...

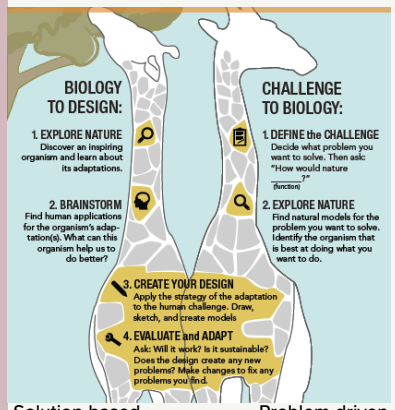
Content

- Introduction
- Living systems leadership framework
- Two short exercises
- Workshop assignment summary
  - (+ another short exercise this afternoon)

Design Process



Bio-inspired design: design by analogy



Solution-based Problem-driven

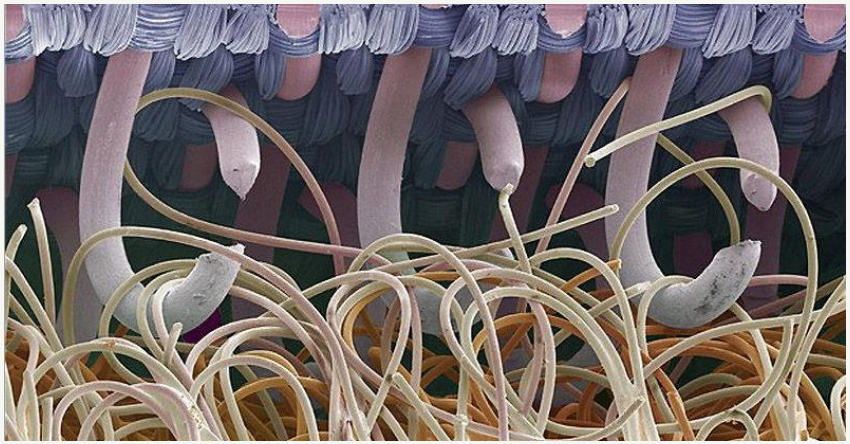


Table 1: Analogy Category Definitions and Examples

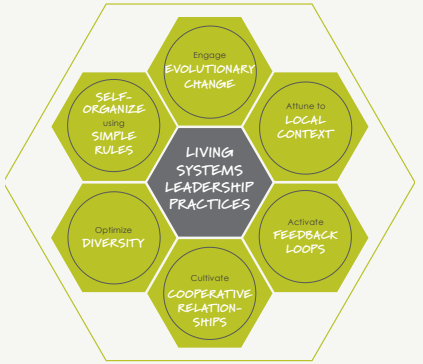
Category	Definition	Examples
Function	The actions of the system or what the biological system does; physiology	Termite mound inspired self heating and cooling buildings, IR detection inspired by fire beetles
Form	Visual features including shape, geometry, and aesthetic features; external morphology	Mercedes-Benz bionic car inspired by fish body shape, High speed train inspired by kingfisher beak
Material	Attributes or substances that relate to material properties	PureBond Adhesive
Surface	Attributes that relate to topological properties; surface morphology	Sharklet Technologies Anti-bacterial surfaces, Gecko inspired dry adhesive
Structure	Internal features including, geometry that support the form; internal morphology; Interconnections among sub-systems	Woodpecker inspired shock absorption, Pigment free color
Process	Series of steps that are carried out; behavior	Photosynthesis based solar cells, Locomotion for robotics
System	High level principle, strategy, or pattern; When multiple sub-categories are present	Wind Farm design inspired by schooling fish

Living systems leadership

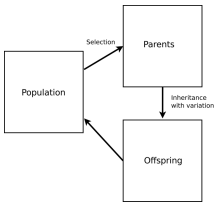
Practices

- Engage in Evolutionary Change
- Be attuned to Local Context
- Activate Feedback Loops
- Cultivate Cooperative Relationships
- Optimize Diverse Networks
- Self-organize using Simple Rules

Brief exercise



The Basic Evolutionary Loop



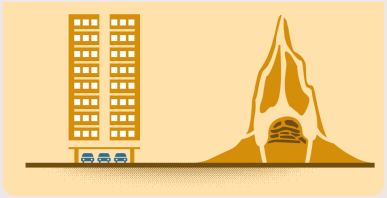
What is evolution doing?

- A common misconception is that evolution has a *goal* or a *plan*.
- In fact, it is just a sequence of random variations, with selection for characteristics adapted for an environment applied.

- We have a tendency as humans to want to plan and control everything:
  - an evolutionary approach would be to try lots of things, fail fast, incorporate what works, and let go of what doesn't.
- To encourage an initiative to adapt and evolve, we need strategies that will
  - Affirm what's working well
  - Integrate the unexpected - welcome "mistakes"
  - Reshuffle information – mix it up
  - Let go of what no longer works

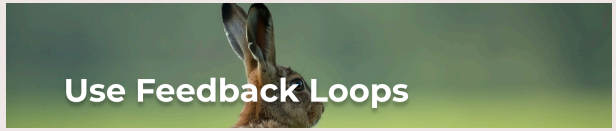
Be Locally Attuned And Responsive

- Individual organisms respond and often acclimatize to new environmental conditions
- At the population level, organisms continually adapt to their surroundings



Be Locally Attuned And Responsive

- Consider the context
  - Respond appropriately to where we are now
- Use readily available resources and energy,
  - in ways that contribute to the thriving of the community as a whole
- Build partnerships that allow us to be who we are and yet extend our reach:
  - What does “local” mean for your efforts? How are you listening for the changing dynamics, and shifting your pitch when there is a need to adapt?



Use Feedback Loops

- Life is constantly communicating – both within and across species:
  - Signalling and responding
  - Feedback loops provide important information to help organisms and systems appropriately respond to change

An example:

ACACIA TREES

& giraffe interaction

- When a giraffe begins to eat the leaves off an acacia tree, the acacia emits ethylene gas to warn the other acacia trees
- Those trees receive this signal and respond, as part of a feedback loop, by also releasing ethylene gas, thereby warning other trees nearby.
- Detection of the ethylene also signals the acacias to manufacture and deliver a toxin in their leaves, as part of a response to further deter the herbivores.

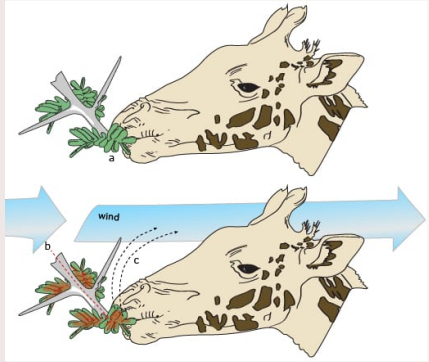
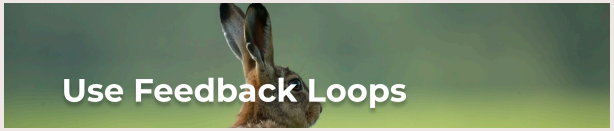


Illustration: Emily Harrington | Ask Nature

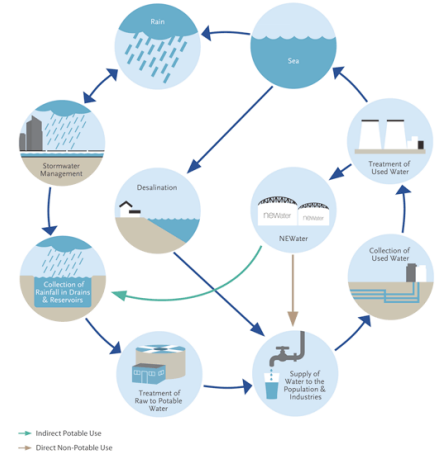


- In organizations and other social contexts, people tend to fear feedback, equating it with criticism.
- Or, we focus on measurement – a predetermined set of information indicators, such as media metrics or financial projections.
- Feedback is different:
  - It is about listening for new signals in the system, things for which you were not looking.
  - It is about having your receptors and antennae open to receive unexpected information, then using it to guide action.

In nature

most feedback loops:

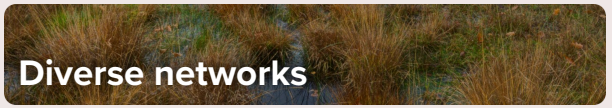
- are short, strong, cyclic, well-tuned between the signaller and receiver...
- and then implemented immediately.
  - Improving feedback loops in our organizations could be the most high-leverage intervention we could use to catalyze innovation and increase effectiveness.

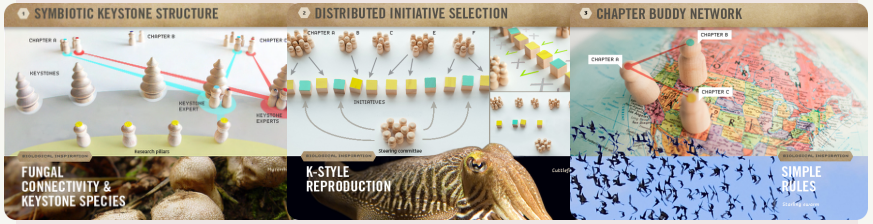


Brief exercise

- "Survival of the fittest" in truth means that those who are most "fit" – most well adapted to their conditions, able to optimize their energy use, and able to partner well with others – are most likely to survive.
- In nature, mutualisms tend to increase in times of stress. In places that are harder to live in, there are more mutualisms.
  - During difficult times (like at the end of the season or in drought), organisms become more cooperative.

- Who might be your unusual allies with whom you can generate new opportunities?
- What stressful situations are you in that may call for you to recognize or find new strategic partners?





- The tricky thing about learning leadership from nature is that in the natural world, no one is in charge.
  - There is no ED or CEO in nature, and yet very complex tasks are accomplished.
- Life builds from the bottom up, guided by simple rules and adapting through feedback loops.
- Complex challenges are sorted out among individuals within a system, who self-organize using a small set of simple rules.

Swarm?

Loosely structured collection of interacting agents

- swarm of bees
- ant colony as swarm of ants
- flock of birds as swarm of birds
- traffic as swarm of cars
- crowd as swarm of people
- immune system as swarm of cells and molecules
- economy as swarm of economic agents
- ...

Swarm Intelligence?

Emergence of complex behaviour via simple agents.

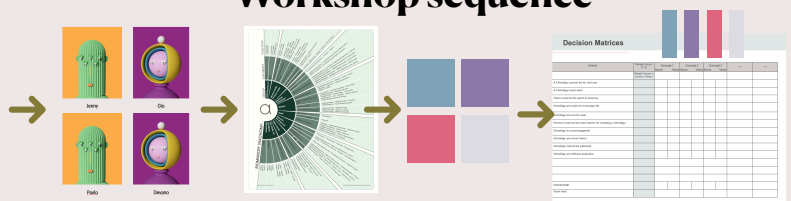
Self-Organize

- What are the simple rules that could allow for self-organization and emergent collaboration in your ‘wicked’ systems?

Brief exercise 2

Summary of workshop

Workshop sequence



Go to mycreativetype.com and find your type - create a group portrait

Find a group/subgroup/ function and create an analogous concept

Add individual concepts to decision matrix

Can a ‘system category’ bio-inspired analogy be found for your project?

Individual work

Group work

Workshop exercise

2 groups: D and E (start of workshop time) and H, I and F (~20 minutes into workshop time)

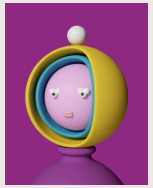
Class D (Group 1 – Group 5): TPM–Hall D (31.A0.250) – w/ **Meghana & Aditya**
Class E (Group 6 – Group 11): TPM–Hall E (31.A0.290) – w/ **Pavlo**

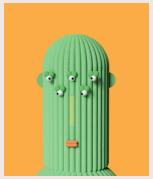
Class H (Group 12 – Group 17): TPM–Hall H (31.A1.210) – w/ **Devano**
Class I (Group 18 – Group 22): TPM–Hall I (31.A1.250) – w/ **Giovanni**
Class F (Group 23 – Group 27): TPM–Hall F (31.A1.020) – w/ **Anggi**

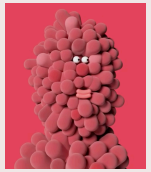
Individual/group

- Go to https://mycreativetype.com
- Find out your type and create a group photo/composition

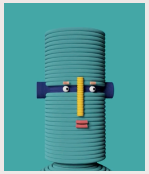
From a past class - Group A

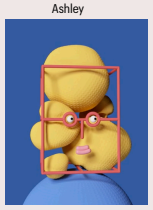

Nathan

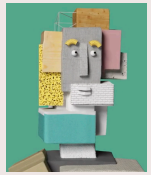

Ashley


Jimmy

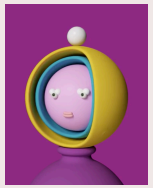

Joshua

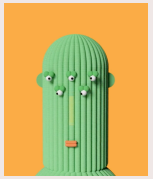

Firaoll

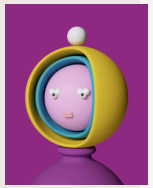

Kenneth

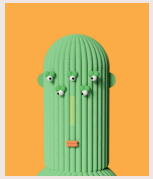

Kate

From a past class - Group B


Daisy


Shulamit


Amanda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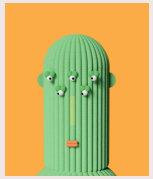
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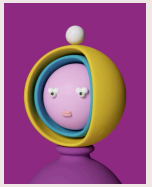
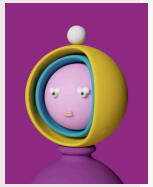

Vipasha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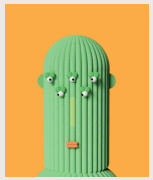
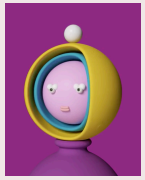

Jenny


Gio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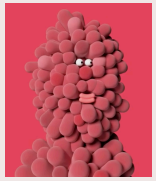
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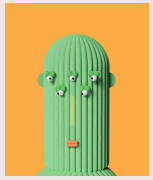
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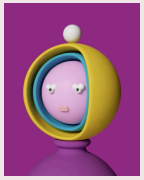
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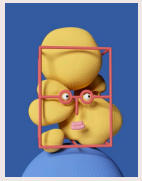
Anggi

Teaching team

Thank you

See you this afternoon