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hybrid event

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Think Like an Ecosystem: Deploying MBSE Within Your Organization

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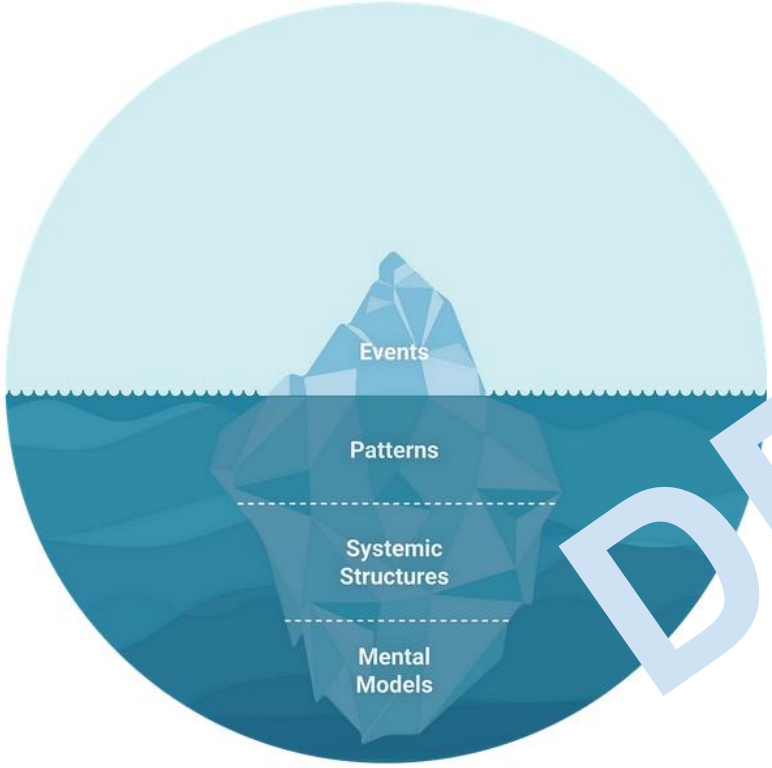
Overview

- Systems thinking and the Nature of Systems

- Bio-Inspired Design Principles
  - How can we leverage nature's genius to help us solve our problems?

- Applying Bio-Inspired Design Principles: Case Study
  - Define the problem: How can we effectively deploy MBSE in our current work environment?
  - Biologize the problem: How does nature adapt to changes or disturbances?
  - Discover: What are the roles, functions and defining characteristics of an ecosystem as it moves through stages of succession after a disturbance?
  - Abstract: What does this look like when translated to our problem?
  - Emulate: What does this *really* look like when applied?

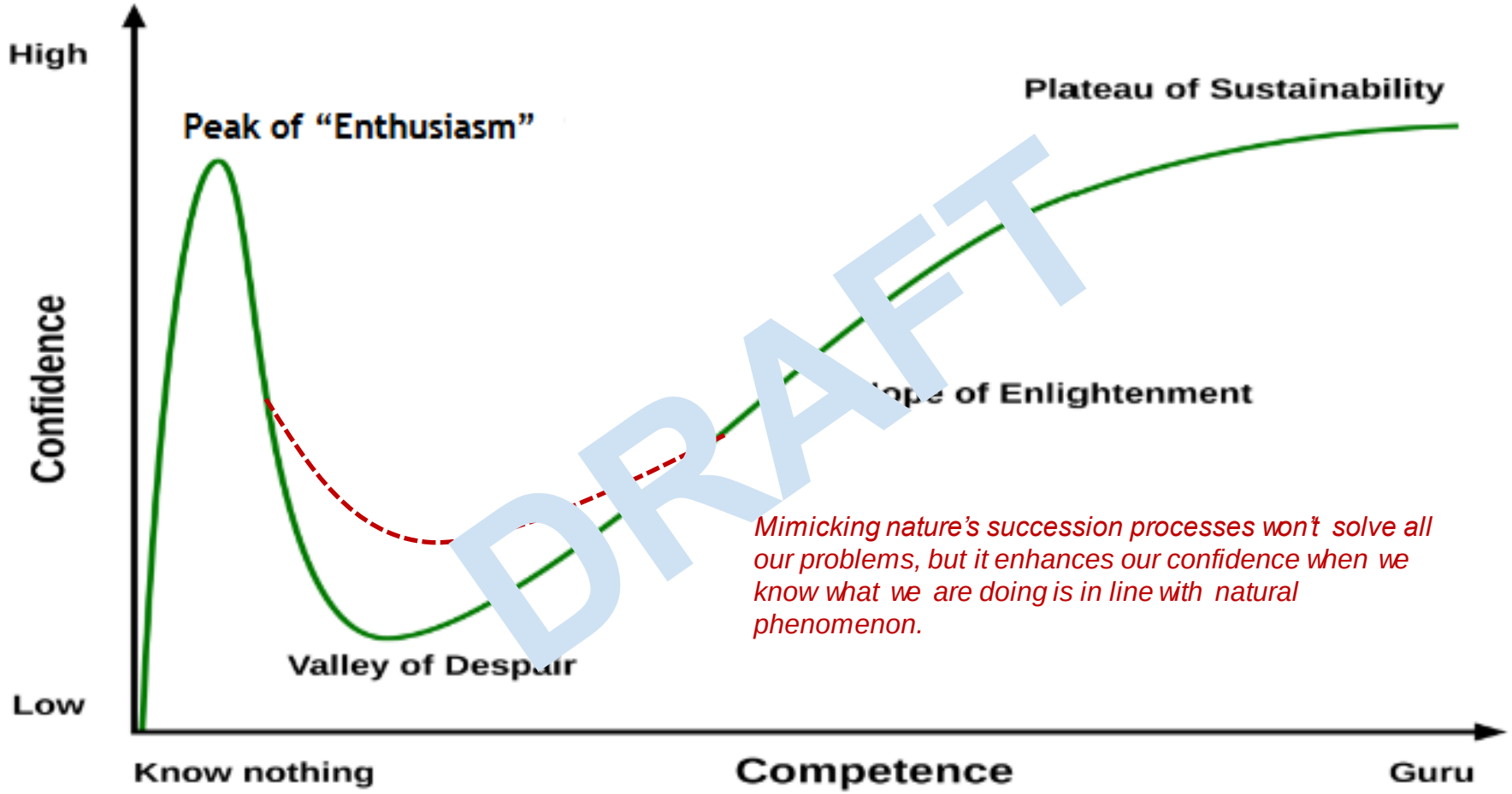
Systems Thinking



LEVELS OF UNDERSTANDING

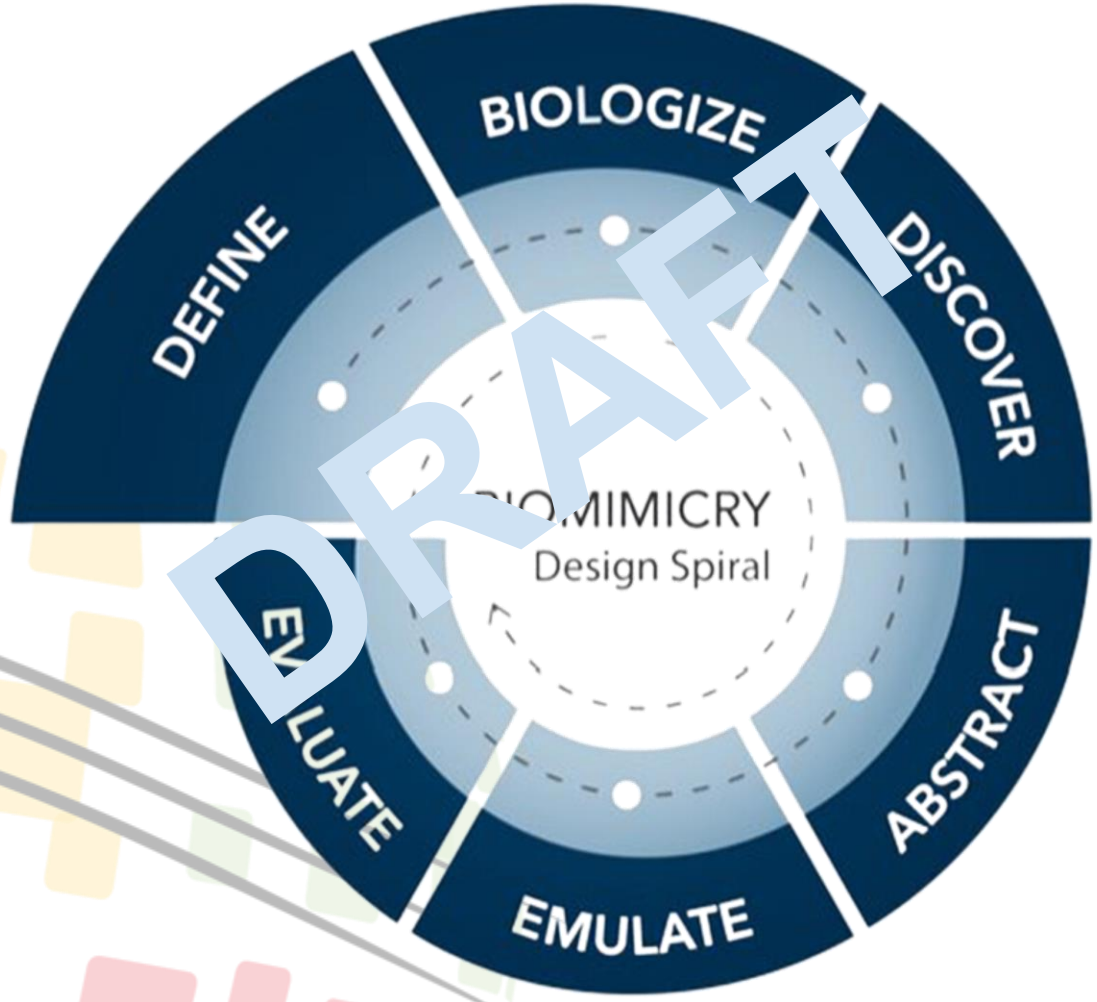
Levels of Understanding	Action Mode	Time Orientation	Typical Questions
Shared Vision	*Generative*	Future	What are the stated or unstated visions that generate the structures?
Systemic Structure	*Creative*		What are the mental or organizational structures that create the patterns?
Patterns of Events	*Adaptive*		What kinds of trends or patterns of events seem to be recurring?
Events	*Reactive*	Present	What is the fastest way to react to this event NOW?

Dunning–Kruger Effect



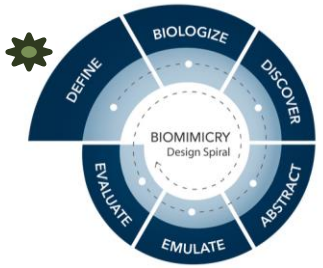
Mimicking nature's succession processes won't solve all our problems, but it enhances our confidence when we know what we are doing is in line with natural phenomenon.

Bio-Inspired Design Process



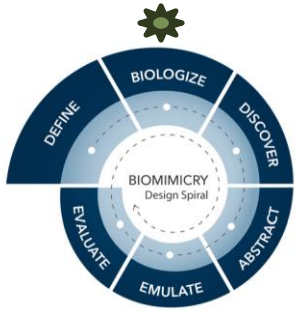
Applying Bio-Inspired Design Principles: Case Study

Define (the problem)



How can we effectively deploy MBSE into our current work environment?

Biologize



How can we effectively deploy MBSE into our current work environment?

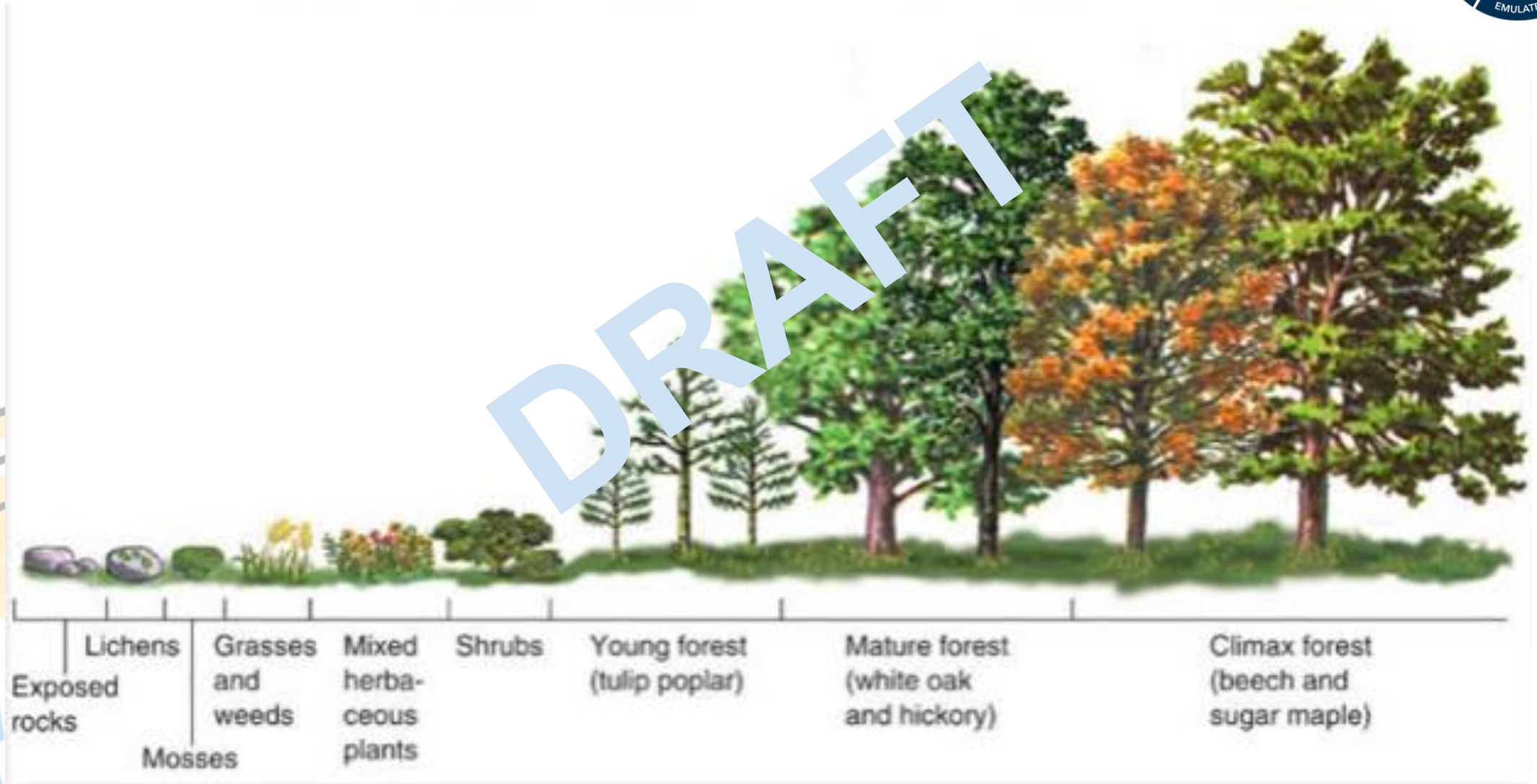
1. Deploy = Change

- How does nature respond & adapt to change/disturbance?

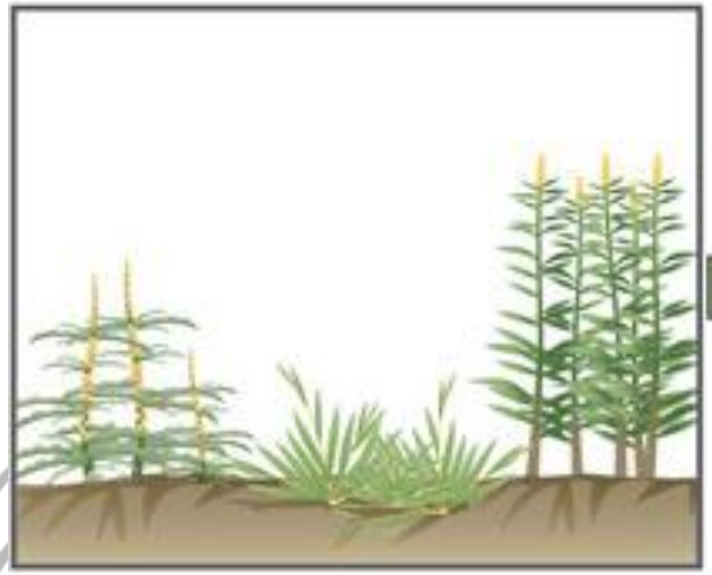
2. Efficacy

- What are the characteristics of efficacy?
- How can that be accelerated (time to maturity, reduced entropy, abundant resources)
- How does nature distribute “good” information (interspecies, intraspecies, over time)?

Discover: Succession

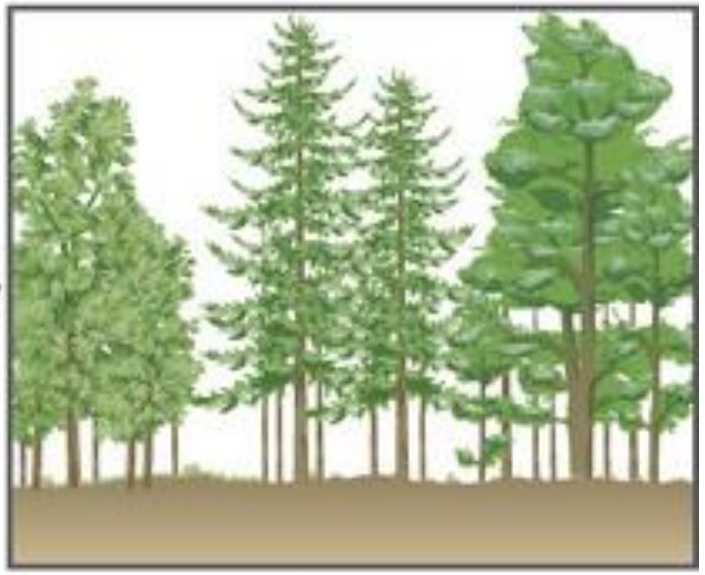


Discover: Succession Stages



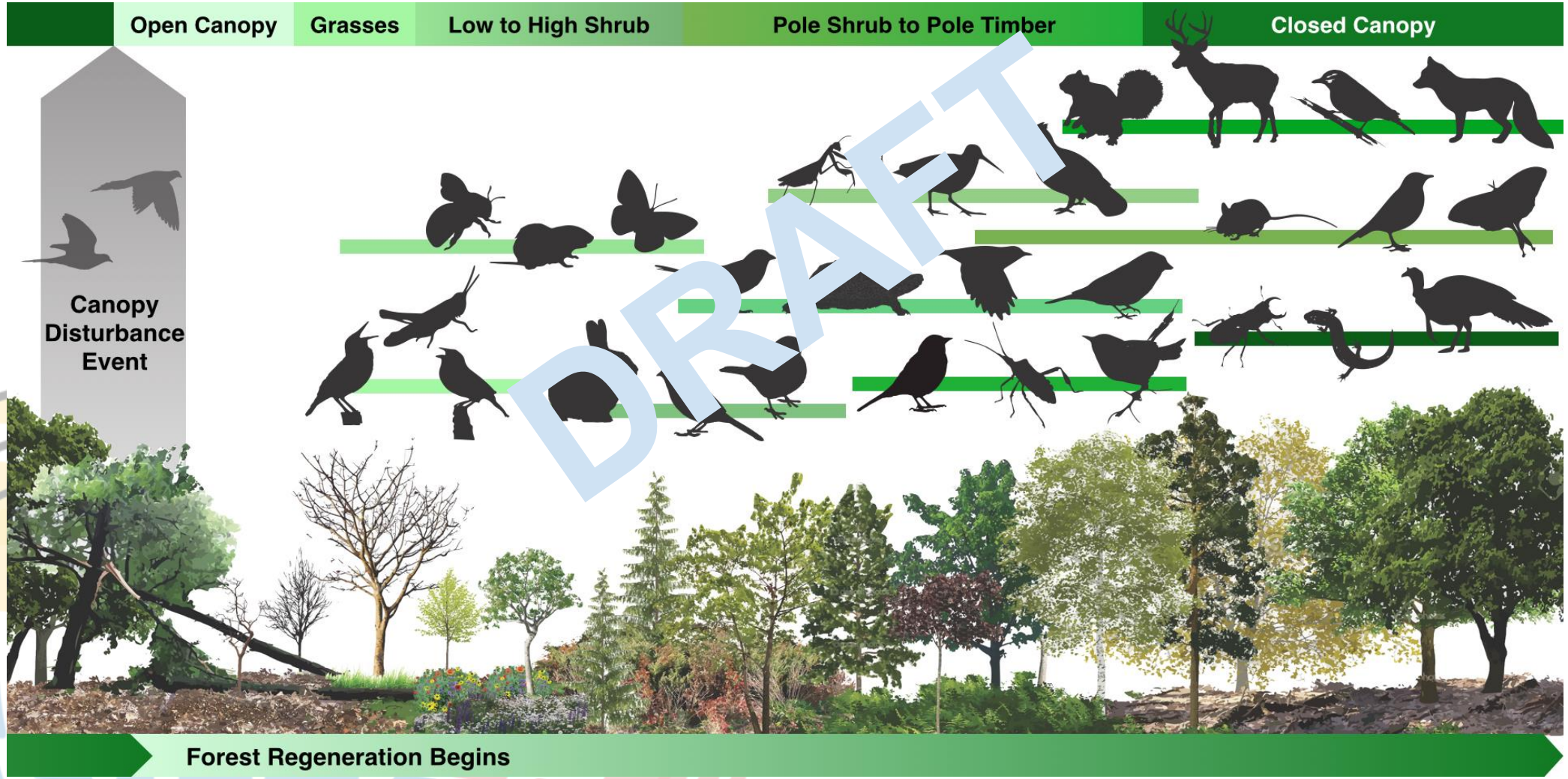
Pioneer species
Annual plants grow and are succeeded by grasses and perennials.

Intermediate species
Shrubs, then pines, and young oak and hickory begin to grow.



Climax community
The mature oak and hickory forest remains stable until the next disturbance.

Discover: Succession



CONTROLS

- Predators
- Hostile/harsh environmental conditions (exposure)
- Resource constraints (lack of water, nutrients, sun)
- Competition for resources (invasive species, large numbers of the same species)
- Repeated disturbances (interruptions in processes/momentum, invasive species)

INPUTS

- - building blocks for growth (nutrients, root structure)
- but no biological activity, not organized or activated
- Water
- Sunlight
- Dormant seeds

PROCESS

Phase 0- Phase 1

1. **Microorganism activity (consuming, producing, decomposing)**
2. **Seeds activating (dormant or otherwise)**
3. **Plants reaching and breaking down rock->releasing minerals**

OUTPUTS

- Complex soil structure
- Increased nutrient availability

ENABLERS

- Transitory species (bring in external nutrients, diversity)
- High levels of sunlight
- Water availability
- Existing infrastructure, resources that have been vetted

CONTROLS

- Transitory species (could contribute to collapse if overconsuming, produce waste that may benefit the ecosystem or could deliver the 'output' to another ecosystem

INPUTS

- New species coming in and fixing/establishing themselves
- New seeds (blown or carried)

PROCESS

Phase 1 → 2

1. **Germinating seeds**
2. **More/larger transitory species coming in (attracted, graze/hunt may not stay)**
3. **Regeneration of existing plant structures (from roots)**
4. **Invertebrates selecting these habitats & establishing themselves**
5. **Soil building (nutrient availability and turnover)**
6. **Soil stabilization (from roots)**

More seeds activating (dormant or otherwise)

OUTPUTS

- Established species / pioneers (specific to available resources)
- Developing habitat
- Low diversity of species (but many of each)
- More complex nutrients/resources available

ENABLERS

- Transitory species (they create balance/competition & manage populations)

CONTROLS

INPUTS

PROCESS

Phase 2 – 3

1. **Germinating seeds**
2. **More/larger transitory species coming in (attracted, graze/hunt but may not stay)***
3. **Regeneration of existing plant structures (from roots)**
4. **Invertebrates selecting these habitats & establishing themselves**
5. **Soil building (nutrient availability and turnover)**
6. **Soil stabilization (from roots)**
7. **More seeds activating (dormant or otherwise)**

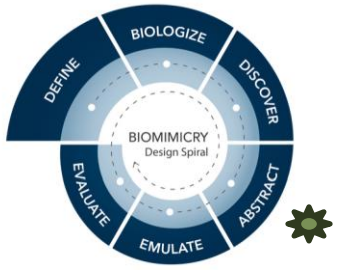
ENABLERS

- Time (turnover cycles)
- Resources
- biodiversity

OUTPUTS

- Higher diversity
- More specialization (and therefore greater sensitivity to change/minor disturbances)*
- More aggregate/complex soil structure
- Water retention in soil
- ? Self-regulating?

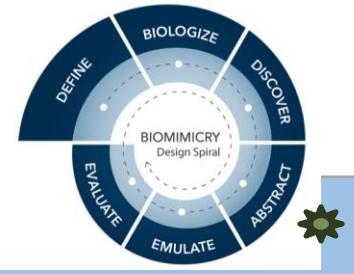
Abstract : Roles



Ecosystem Roles	Organizational roles (personas or job titles)
Predators	C-suite, Decision Makers
Ecosystem Engineers/Architects	Principals, Strategists, Early adopters/Pioneers, Pathfinders
Mutualists	Connectors, Networkers, organization members, messengers
Producer / Pioneer / Pathfinder	MBSE champions, early adopters, modelers themselves, establishing best practices, capturing & sharing core learnings to the rest of team/future users
Consumer	Nominal users, consuming information, taking and building on the learnings and products of producers/pioneers, provide feedback
Decomposer	Lower level, technical managers, but also individual contributors who are daily users

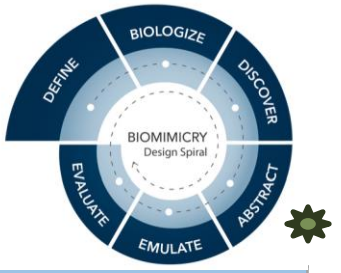
Succession States of Ecological and MBSE Ecosystem

Emulate: Stage 1



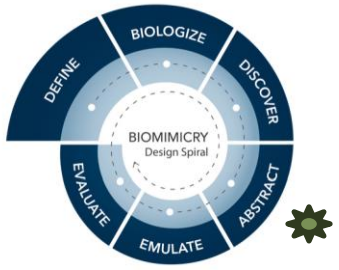
Ecosystem Characteristics in Stage 1 of Succession	Translation to SE Effort <<move these to next two columns>>	Recommendation for managers: for MBSE implementation and to guide transition to next stage/type	Recommendation
a.Limited diversity b.Short life cycles c.High rates of energy loss d.Limited cycling of nutrients (r-selected species)	Few modelers on the team, limited experience, expertise, perspectives or SEs or modelers to bounce ideas around a.Models are built for a specific purpose, used only in a limited duration of the system development. Lots of 'bad' models produced, thrown away or used only once. b.Lots of time, $, resources spent getting people trained, educated on MBSE and its use/value, for small returns d. models, modeling skills and learnings are "nutrients" here, and because of the limited number and diversity of modelers, the nutrient cycles are slow and limited	Assign dedicated modelers, place them together ("shared DNA") and each on a variety of projects ("environmental adaptation") so learnings can be applied immediately. This team should comprise early adopters, champions who are adaptable to change and excel in trial/error mentality. a.Capture learnings & document best practices (see (a)) so that the modeling practices evolve b.Start with requirements, …and? Build with small, simple, understandable and reusable elements (*LP) c.Discuss value proposition of MBSE, think about outputs, use those to guide inputs to get the value you are seeking. d.Encourage those who are interested or curious. Welcome them, involve them, create a collaborative, non-punitive and non-competitive environment e. Build/encourage crevice communities, cohorts)	a.Choose 3-4 diagrams and get familiar with their use (Act, STM, REQ, BDD). Practice, learn pros/cons/value to stakeholders a.Model--sync with stakeholders--update assumptions/model b.Recognize there is a steep learning curve, lots to learn in the beginning, communicate that with your teams/manager, stay fluent, practice often, request models from others c.Recognize lots of models will be abandoned d.Capture learnings so the modeling practices evolve, building on early trials, mistakes and successes ('code' future DNA e.Encourage those who are interested or curious. Welcome them, involve them, create a collaborative, non-competitive environment

Emulate: Stage 2



Ecosystem Characteristics in Stage 2 of Succession	Translation to SE Effort <<move these to next two columns>>	Recommendation for managers: for MBSE implementation and to guide transition to next stage/type	Recommendations for modelers
a. longer life cycles b. low energy loss c. perennial growth (k-selected species) d.New forms of complexity e.Low diversity f. Transitory species *The rate at which species disperse to a site can dictate the rate of succession (Ref Nature.com)	a. Model is built (and utilized) earlier in the development effort and is maintained after deployment b. Subset of training is extended to additional team members, distributed by internal team members and the gains from use of MBSE offset new training, project overruns c. Models are updated, re-used for change management, obsolescence, shared between platforms or similar projects. Glossaries and libraries are created and reused	a. Use the tools to model your development or modeling process. Use swimlanes to define phases of development or functional groups. Use these to communicate to teams and familiarize them with the terms and diagrams. Encourage use through product life cycle, bring external content in via hyperlinks. b. Struggling to establish connections, integrate software. Lots of trial and error. c. Establish mentorship programs, create chains of mentors (DNA transfer). f. Connect the mentees in the various branches, encourage cross-pollination	a. Spend some time "on the plateau," applying what you have learned, developing best practices and reinforcing foundational concepts. Once grounded, take an incremental step in learning, then spend time on that next plateau. (The learning curve is neither a curve or a diagonal line. There will be many "Ahhhh, I see now" moments that will propel you up to the next step.) b. (and c.) Create glossaries, libraries (e.g. requirements, interface definitions, generalizations of block definitions, Activities), create a template for setting up your model. Create smart packages, bring external content in via hyperlinks. c. Spend time on a handful of diagrams, to understand their purpose, strengths, weaknesses and value in various stages of the system development life cycle.

Emulate : Stage 3



Characteristics of an Ecosystem in Succession Stage 3	Translation to SE Effort <<move these to next two columns>>	Recommendation for managers: for MBSE implementation and to guide transition to next stage/type	Recommendations for modelers
a.Longer life cycles b.Low energy loss c.Perennial growth (k-selected species) d.High species diversity e.Interconnected networks Climax community	a.Same as above…but more b.Model templates and patterns are used. c.Same as above…but more d.More organizational roles are viewing and using the models to extract reports, analyses, etc e.SysML models are integrated with other modeling tools in the modeling platform (UML, math engines, mechanical, thermal, electrical, simulators, etc) and rolled up into UAF, BPMN and SoS models		d.Share your learnings, train/mentor co-workers, new generations of modelers (ants - teams of 3) a.Learn about integration tools within the modeling platform (UML, math engines, mechanical, thermal, electrical, simulators, etc) and rolled up into UAF, BPMN and SoS models