Sustainable Solutions Workshop 2015

June 17, 2015 webinar #4

Agenda:

✓Intent of Class
✓Introduce Intern Sheridan
✓ Discussion re: Class 3 Homework
✓iSite sharing
✓Case study
✓Review of function and discovery phase
✓Abstracting design principles
✓Class 4 Homework
✓Questions and comments

I'm so excited to meet and work with you all on your projects!

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Communication Tools

Virtual Team Meetings

Doodle

Features

Schedule an event

www.doodle.com

Skype

www.skype.com

Hangouts

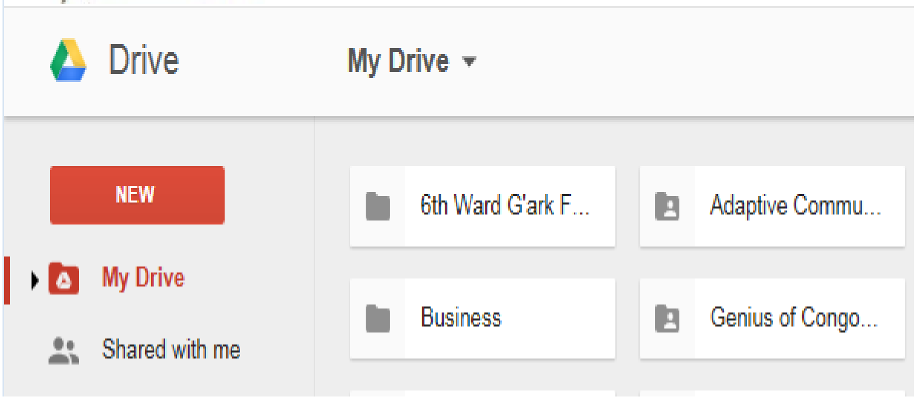
https://plus.google.com/hangouts

Virtual Collaboration

Evernote

www.evernote.com

https://drive.google.com/drive/my-drive



SS Biomimicry Workshop 2015
Team's Selected Functions

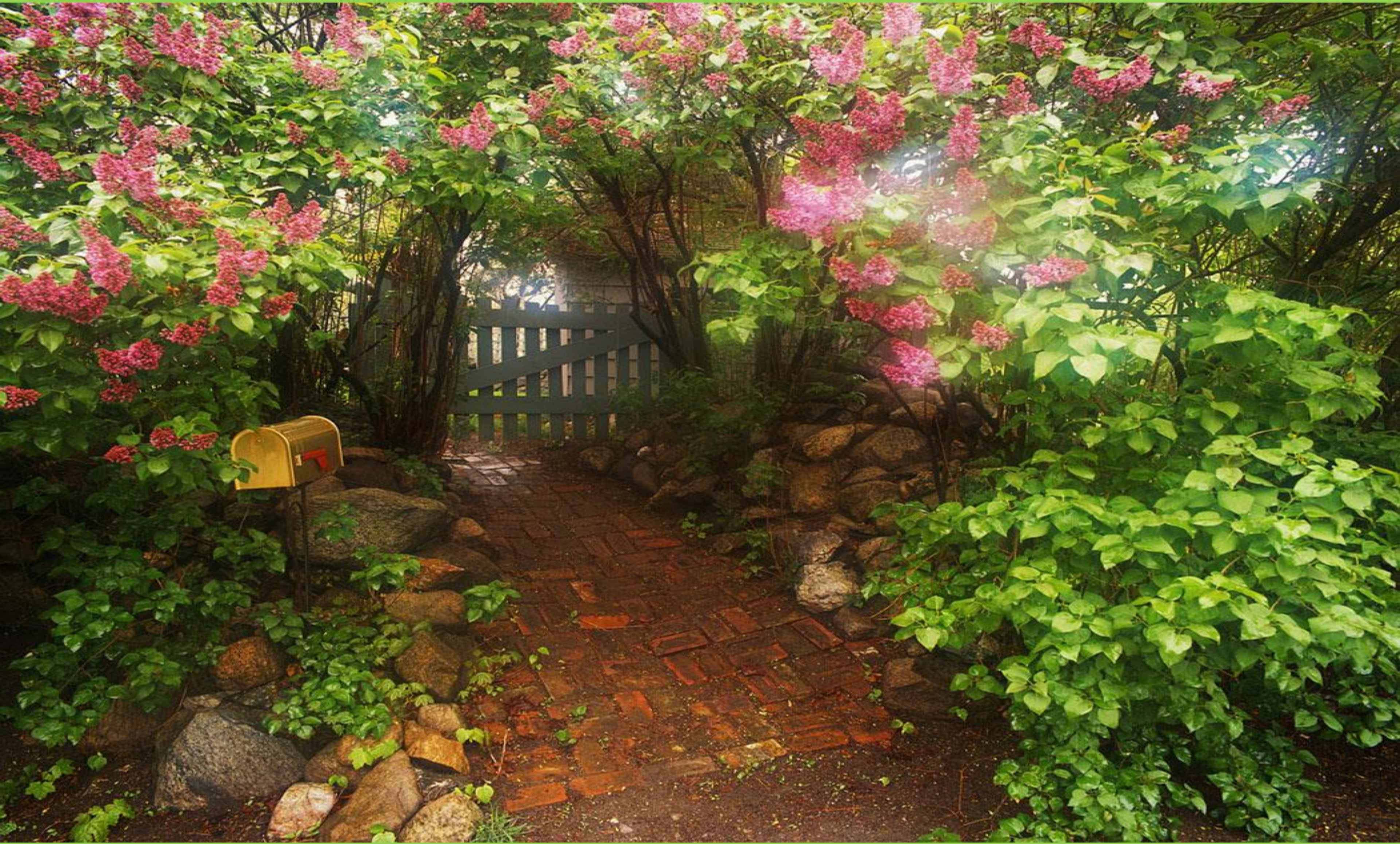
Climate Change: How does nature adapt to changing water availability?

Communicate: How does nature communicate between species and to the young?

Team Lifeblood: How does nature foster a connection and maintain symbiotic relationships?

Team Disturbandets: How does nature manage extreme amount of water both physically and chemically?

iSite



Reconnecting with Nature = actually being in Nature

iSite sharing

Columbia Forest Products and Blue Mussels

Biology to Design

Photo credit: Andreas Trepte

Design to Biology

PureBond®
HARDWOOD PLYWOOD

Biomimicry at work
Boulder's Open Space and Mountain Park

OSMP Mission

The Open Space and Mountain Parks Department preserves and protects the natural environment and land resources that characterize Boulder. We foster appreciation and use that sustain the natural values of the land for current and future generations.

OSMP Scoping Phase

Project Criteria:

- Viable project that could be used as a demonstration site for visitors.
- A project timeline that allowed for in depth thinking to discover a solution
- One that could be replicated
- Education and involvement with the OSMP employees

The challenge chosen was the resurfacing and transition of Bluebell Road into a sustainable trail, able to handle emergency vehicles using earth friendly materials.

OSMP - Identifying the Function

Identifying the function:

- How does nature maintain shape under forces of sheer and compression?
- How does nature shed water?
- How does nature enhance infiltration?

Discover Phase

Biologist lead the research:

- Two brainstorming sessions with biologist
- Generate list of local organisms, processes, or ecosystem patterns performing the functions
- Educate OSMP how to conduct biological research

Challenge: identifying champion organisms

Sources of information on local organisms:
- Documentaries
- Nature centers
- Tertiary literature – books
- Secondary literature – journals
- Primary literature – ask biologists or researcher
- National parks or protected areas
- Traditional Ecological Knowledge

Sheridan Cook, EPA Intern, can help

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Tips on finding biological information

- Ask who here is well-adapted to that condition?
- Your selection criteria then needs to be focused more about *what strategies* are most relevant to your particular challenge.
- What kind of organisms might need to specifically adapt to this condition?
- You can also look in similar habitats in other parts of the world, and more often than not, there is an "equivalent" creature in that habitat.

OSMP Discover Phase Results

Results:

- 75 ways nature prevents deformation
- 60 ways nature creates a waterproof barrier
- 50 ways nature enhances infiltration

A link to the final report can be found at: https://bouldercolorado.gov/links/fetch/24170

Biomimicry Framework (IBD)

- **Scoping phase:** behind-the-scenes preparation or "leg work"
- **Discovery phase:** The process of exploratory research to seek inspiration for design.
- **Creating phase:** Glamorous stage of design, options are explored, brainstorming
- **Evaluating phase:** Is used to determine if goals and metrics are met.

Biology to Design Methodology

- Find unique natural models
- Abstract the deep patterns and principles
- Identify potential applications
- Play and design
- Integrate Life's Principles into the design brief
- Evaluate using Life's Principles
- Thank Nature for the inspiration

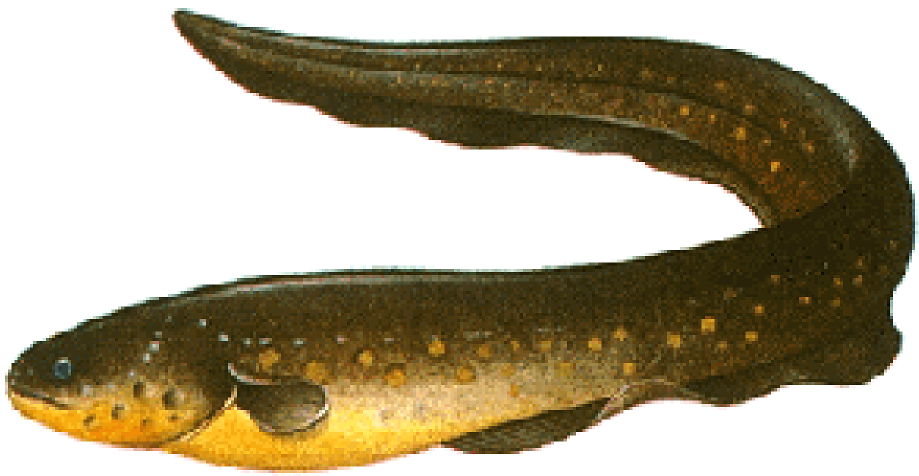
Integrating Biology into Design - Abstracting

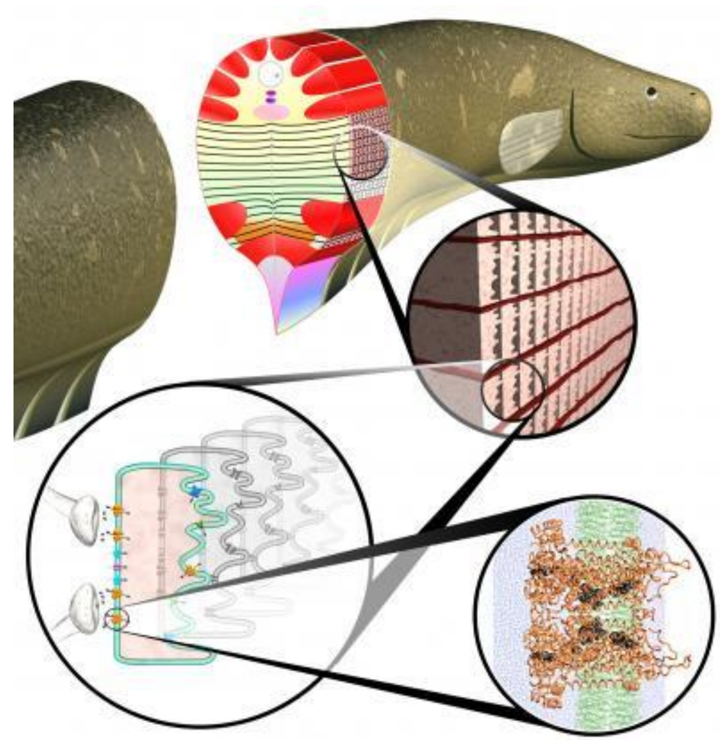
The abstracting steps:

1. distilling the biological mechanism
2. translating them into design principles

Abstracting is one of the most critical components of practicing biomimicry and also one of the most difficult.

Abstracting - the electric eel





Function (what nature is doing)= hunting prey

Strategy (how the function is achieved) = release an electric charge into water to stun its prey

Mechanism (how the strategy works) = uses ion pump to create a charge separation across the cell membrane

Abstracting- Prairie Dog Tunnels

Cross section of a prairie dog burrow. (Drawing by Mark E. Marcuson; courtesy University of Nebraska–Lincoln, Department of Forestry, Fisheries, and Wildlife)

form process ecosystem

Integrate Biology into Design – Abstracting

- The next step of abstracting is the translation from the biological mechanism to a design principle
- A design principle captures that essence of the biological strategy and translates it in such a way that it is biologically accurate, but devoid of confusing biological jargon.

OSMP - abstracting nature's ideas

Organism: Western meadowhawk dragonfly

Function: Deform and regain shape

Mechanism: Resilin deforms when stretched, then releases this energy once tension is eased, returning to its original undeformed shape

Abstracted Design Principle: A protein based elastic material deforms under tension and regains its original shape when tension is released

OSMP - abstracting nature's ideas

Organism: Ponderosa Pine

Function: Uniformly distribute stress

Mechanism: To distribute stress uniformly, trees add wood at points of greatest mechanical load.

Abstracted Design Principle: Add material at points of greatest mechanical load to uniformly distribute stress.

Abstracting Design Principles

Example from the CU Boulder Biomimicry Club:

- Challenge: Recreate a mutualistic relationship between humans and their food systems.
- Biologized question (function) : How does nature form a mutualistic relationship and a network of communication?
- Inspiring organisms: microryza fungi

How does the network of communication work Thru cellular exchange, the information is passed from one cell to another.

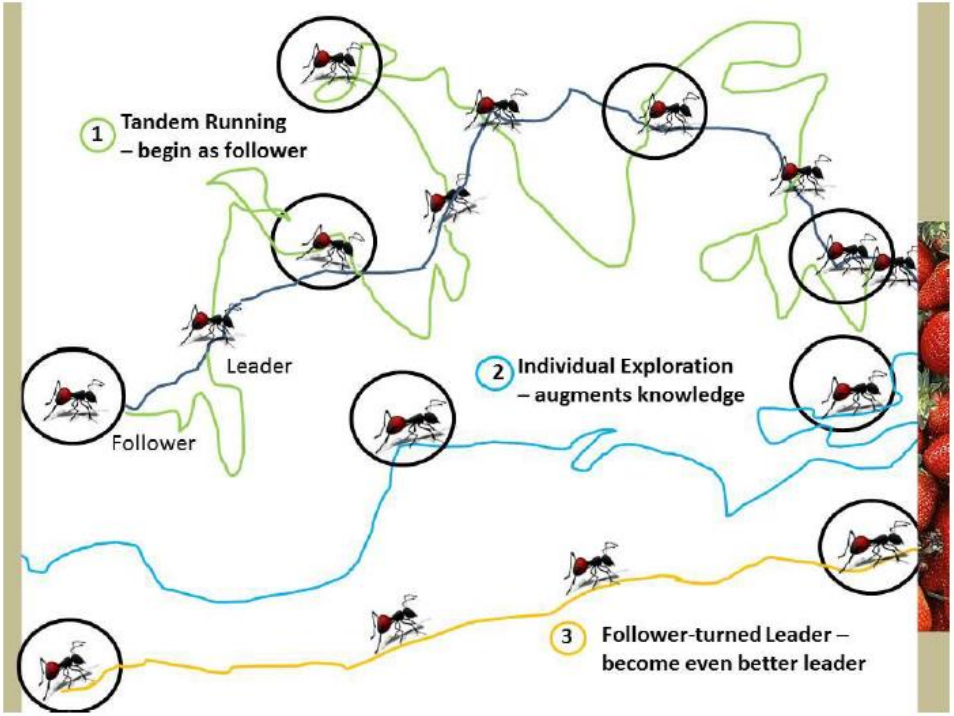
- Abstracted design principle:

  The message sends itself using low energy processes.

BioBrainstorm – *How does Nature Learn?*

Tandem Running Ants

By combining teaching with individual exploration, tandem running ants promote cooperative behavior and efficient information transfer to solve complex social problems.

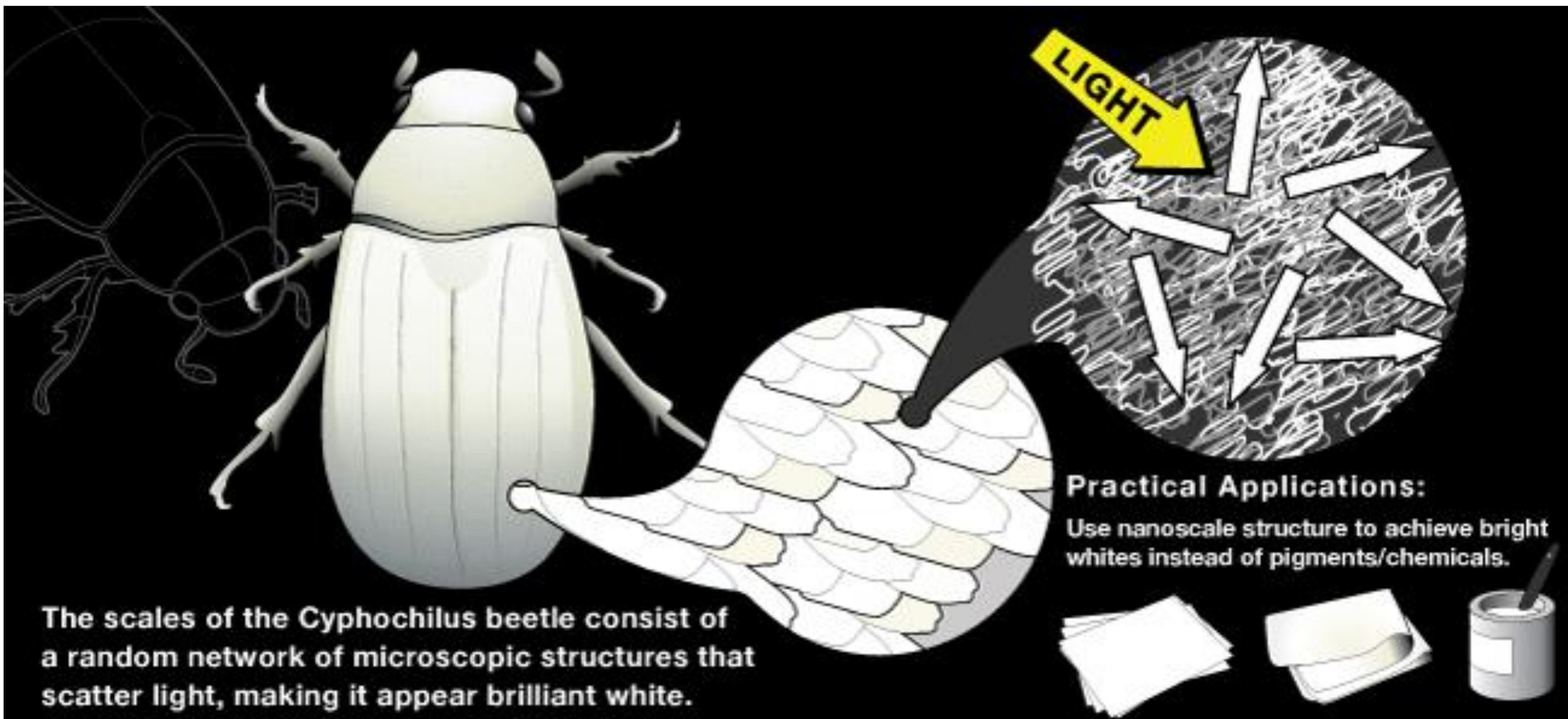


Homework – complete before next webinar on July 15

A) Challenge research
  - ✓ Begin accessing biological information
  - ✓ Contact Sheridan
  - ✓ Set up work process

B) Abstract worksheet
C) Read OSMP study
D) iSite
(Nothing to submit)

Beetles in the Cyphochilus genus achieve their striking white coloration not through chemical pigments, but through a disordered tangle of 250 nm-diameter filaments in their scales. The fibers are sparsely packed with just the right number of voids, giving rise to a thorough scattering of light that causes the brilliant whiteness. The secret is not in the material itself, but the structure—the way the meshwork of fibers and voids scatters the light. Unlike colors, which can be created by using highly ordered structures to scatter light, white is created by a random, simultaneous scattering of light.



The wings of the **cabbage butterfly** offers an interesting example of the biology of wing coloration. The white color is caused by strongly scattering structures in the wing scales. The reflectance is only high above 450 nm, but it is minor below 400 nm, because the scales of male P. rapae crucivora contain a substantial amount of UV-absorbing pteridins." The wing scales are marked by longitudinal ridges and cross-ribs. The cross-ribs are studded with ovoid beads. The wing scales strongly scatter, but due to pteridin pigment, which strongly absorbs in the UV, the reflectance is low in the UV.


Questions?