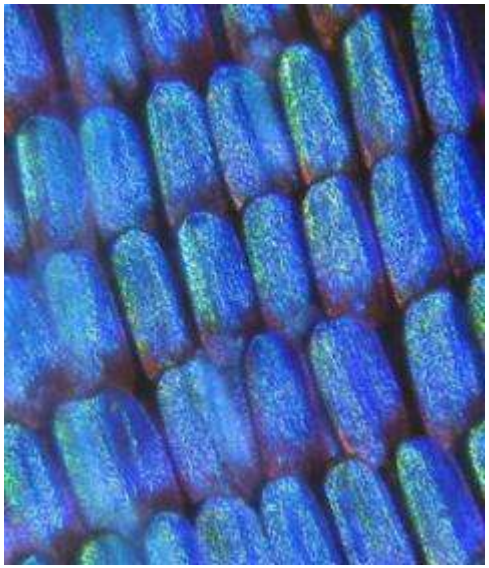
Solutions from the Tree of Life:
biomimetics as a tool in biology education


Emilie Snell-Rood
Dept. Ecology, Evolution and Behavior, University of Minnesota

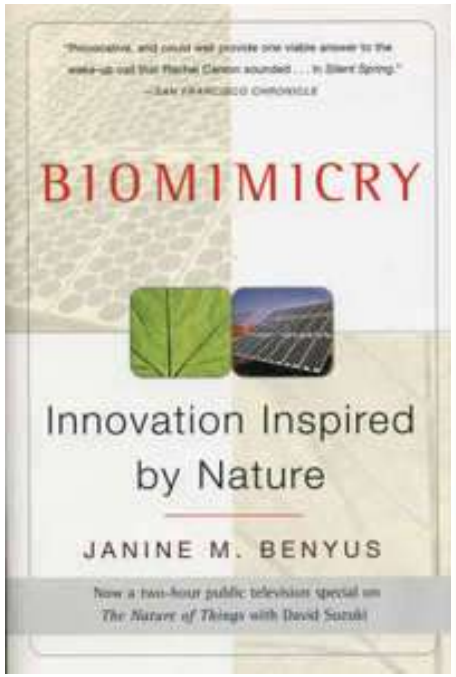
Challenges in Biology Education

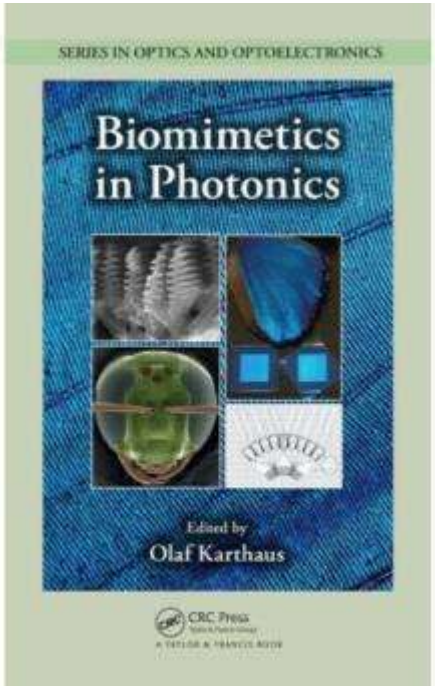
- Engage our students & demonstrate real-world importance of biology
- Teach fundamental concepts and skills from ecology, evolution, and science in general
- Promote integrative, interdisciplinary thinking

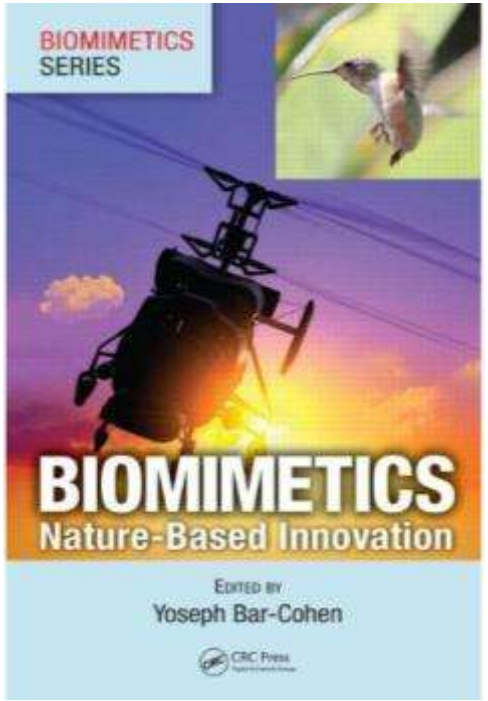
The field of biomimetics is an excellent tool to accomplish all of these education goals.

What is Biomimetics?

- A field which looks to how organisms have solved similar problems





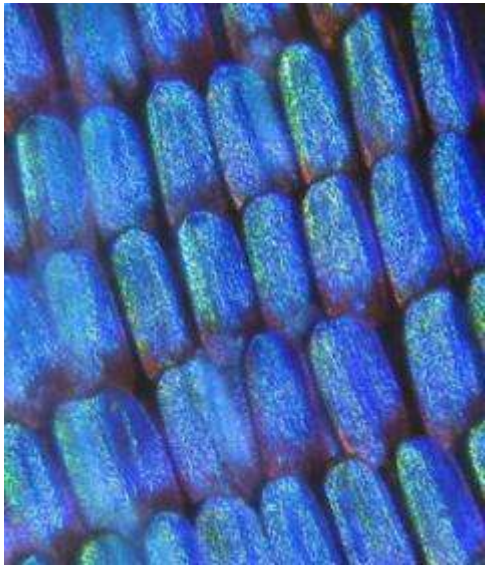


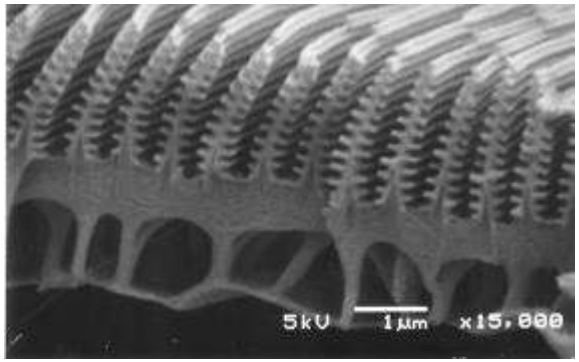
Challenges in Biology Education

- Engage our students & demonstrate real-world importance of biology
- Teach fundamental concepts and skills from ecology, evolution, and science in general
- Promote integrative, interdisciplinary thinking

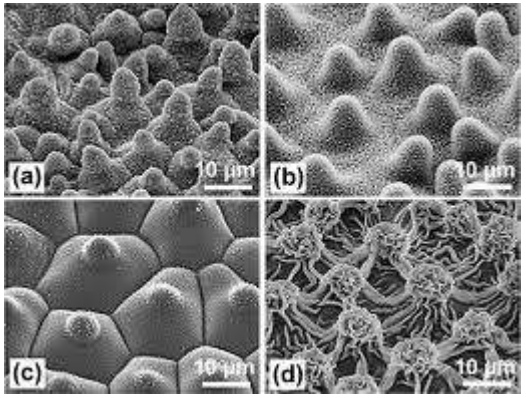
Start with problems that concern the students in the class

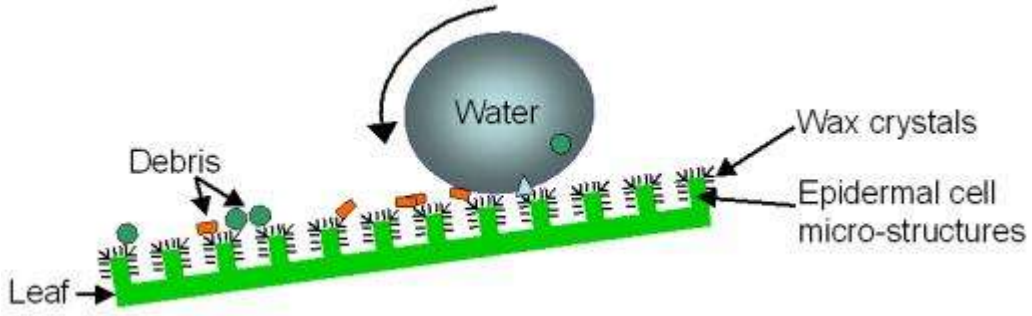
Examples are immediately engaging: Structural coloration and photonics



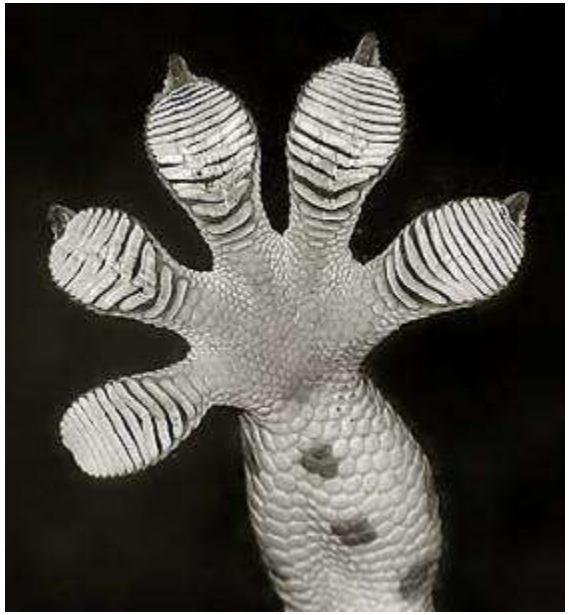


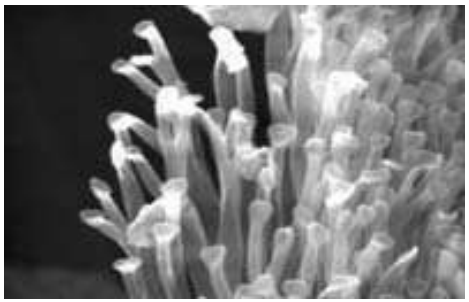
Examples are immediately engaging: Lotus leaf & self-cleaning surfaces

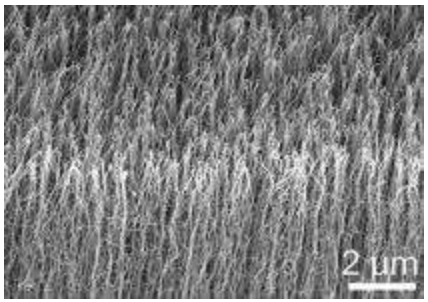




Examples are immediately engaging: gecko feet & adaptive adhesives







Observation of the Natural World

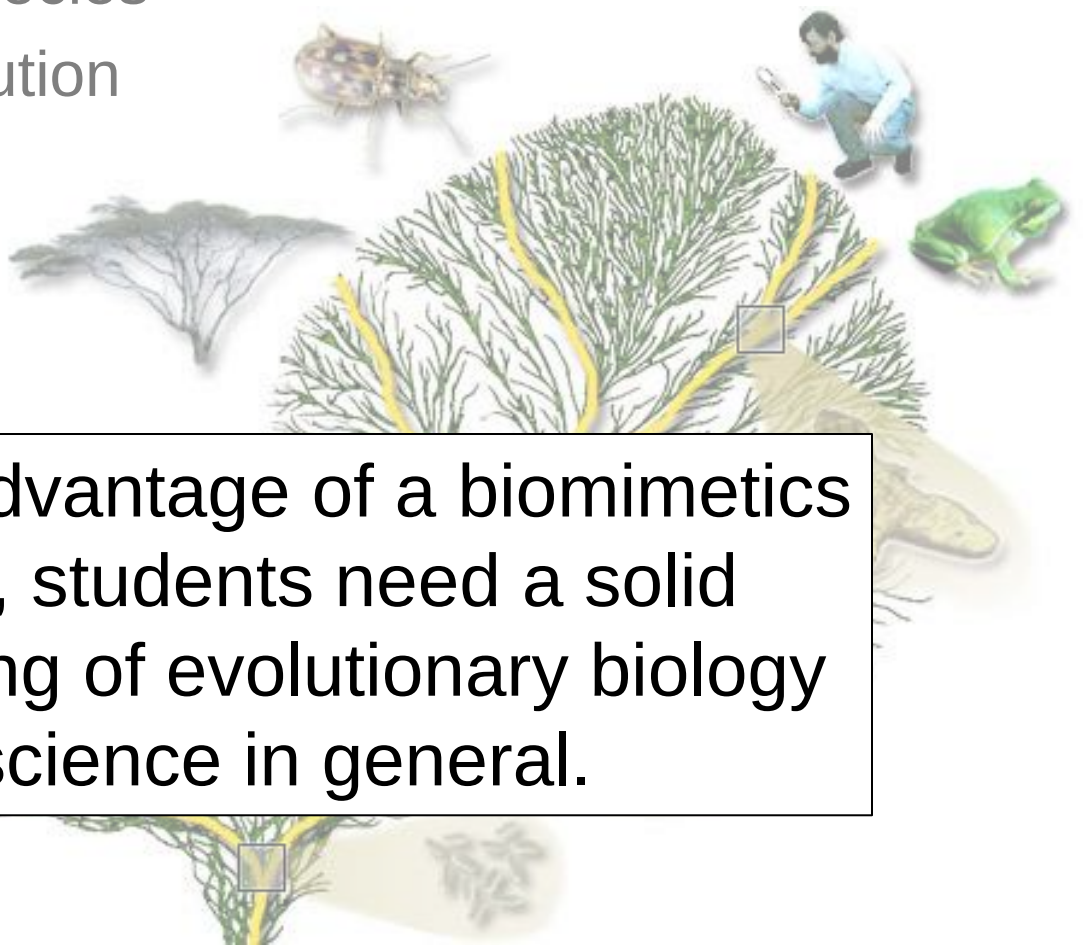
- *“What are these organisms particularly good at? Could we inspire a design based on how they do something?”*

Challenges in Biology Education

- Engage our students & demonstrate real-world importance of biology
- Teach fundamental concepts and skills from ecology, evolution, and science in general
- Promote integrative, interdisciplinary thinking

Biodiversity offers many opportunities for Biomimetics

- 1.3 million described species
- 3.8 billion years of evolution

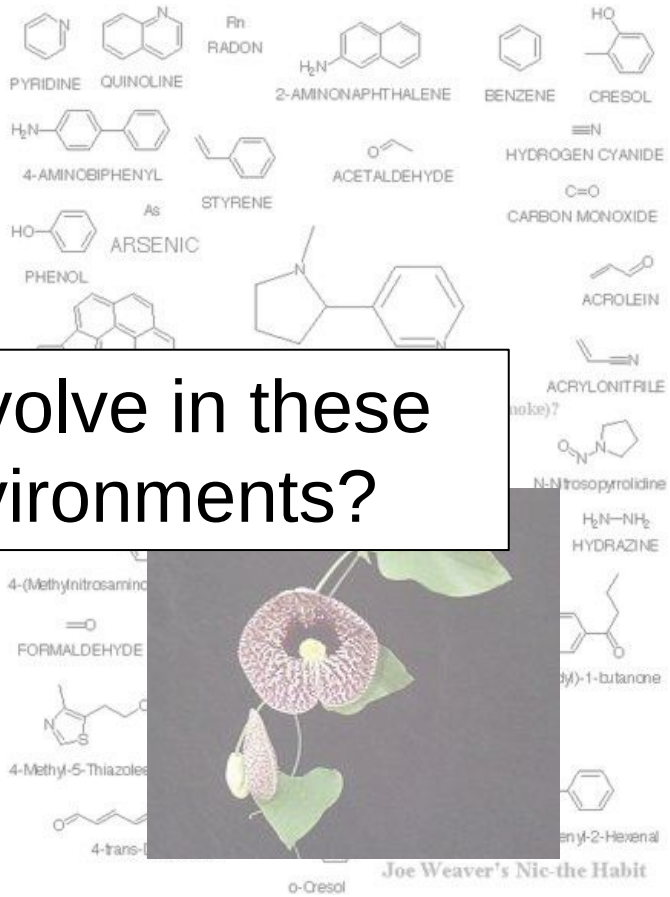


To take full advantage of a biomimetics approach, students need a solid understanding of evolutionary biology and science in general.

Distilling Problems into Selective environments

Water conservation

Carcinogens

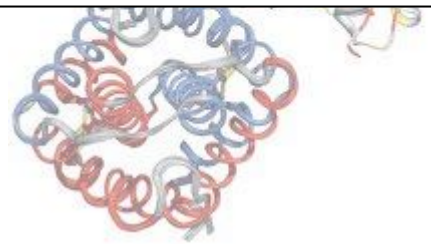


How do populations evolve in these biotic and abiotic environments?

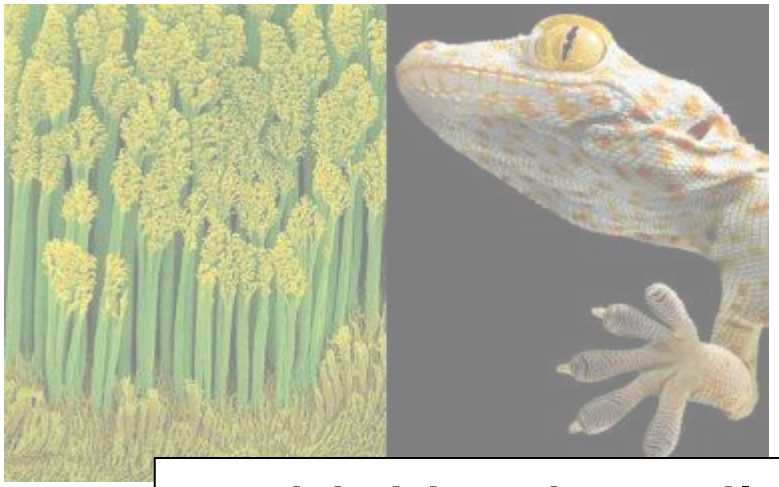
What is the adaptation?

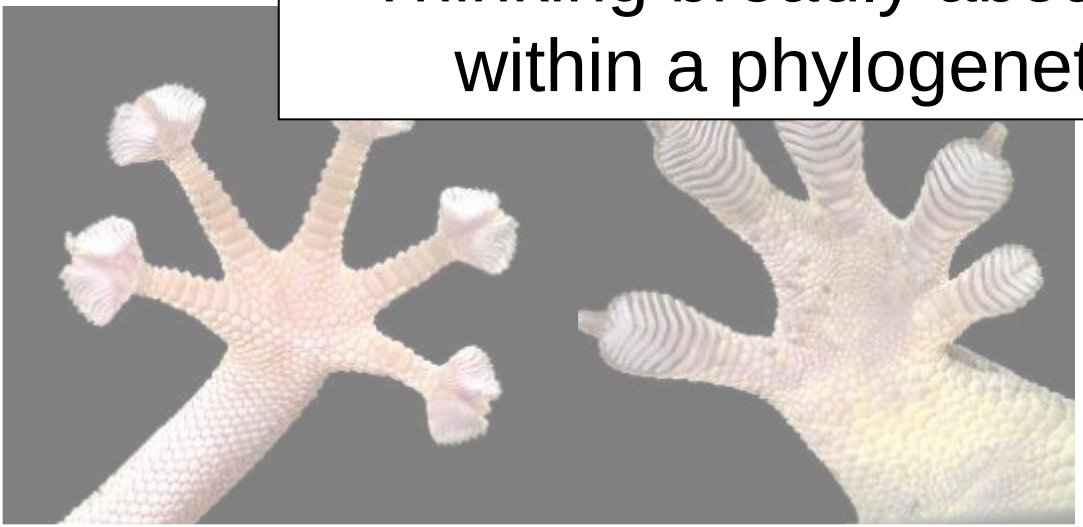
Forces: 1200 g
(>100x concussion)

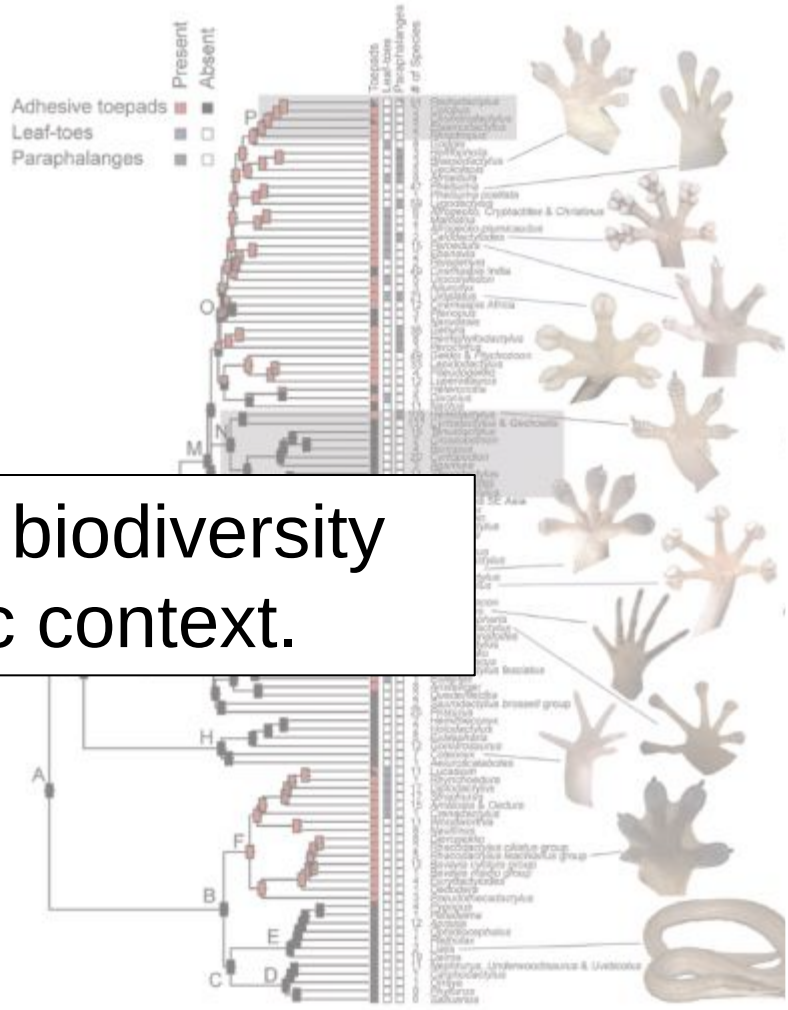
Evidence-based reasoning, experimental design, techniques and methods in biology



Are there multiple, diverse solutions to a problem?







Thinking broadly about biodiversity within a phylogenetic context.

Gamble et al 2012 PLoS One

Understanding Evolutionary Constraints

- Evolution often produces “imperfect designs”

When humans act as engineers, we can take bio-inspiration from multiple sources – we are not constrained in the same way as the process of natural selection.

The verted retina

The inverted retina

Challenges in Biology Education

- Engage our students & demonstrate real-world importance of biology
- Teach fundamental concepts and skills from ecology, evolution, and science in general
- Promote integrative, interdisciplinary thinking

Biomimetics is fundamentally an interdisciplinary field

Structuring Collaboration

- Teams of biologists and designers

Class Projects

- Researching biology – proposal for what data to collect next
- Exploring possible designs

Challenges in Biology Education

- Engage our students & demonstrate real-world importance of biology
- Teach fundamental concepts and skills from ecology, evolution, and science in general
- Promote integrative, interdisciplinary thinking

Developing Biomimetics as a Educational Tool

- Continue teaching & developing this course
- Longer-term plan – write a (very basic) textbook on the topic
  - Tools from evolutionary biology


THANK YOU!