

**The University of Akron
Department of Biology**

3100:318 Biomimicry Design Challenge

3100:318 Spring 2019 3 credit hours

Location TBD

Thursday 1:45-4:30

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COURSE DESCRIPTION

The course Biomimicry Design Challenge is focusing on a studio design exercise, using nature as a model for creating innovative solutions targeting a specific design problem. It combines a brief introduction into biomimetics methodology with research into the specific area given by the task.

- The introduction part is on biomimetics methodologies and tools.
- The studio or design part is a solution based biomimetic approach, that takes on nature to inform a given design task. For this part independent student work in research and design is required. The research on the technical task, the selection of the biological role model, research, abstraction and application to a new design is carried out in continuous interaction and feedback involving external sources and experts.
- The course outcomes are specific design solutions for the given technical problem.

Each year, the course focuses on a specific technical task that may be connected to a current research project or theme, involving an external partner as a client. The course includes site visits, interaction with a client, analysis of the task, development of a conceptual approach, definition of a functional requirements catalogue, analogy research and search for biological role models, literature research and basic research in biology, design of specific solutions to the given problem area, designing of new solutions and proposal, experimental design and prototyping, presentation techniques.

As project outcome, drawings, visualizations, descriptions, analogue models and prototypes are envisioned.

The course is open to students from different disciplines in the arts, sciences and engineering. Interdisciplinary collaboration in small groups is envisioned.

The course is held weekly on Thursday afternoon.

RATIONALE

- For the students, the goal of the course is to understand and apply biomimetics as a methodology of information transfer from nature to design in a real world scenario taking on an existing design target in cooperation with a client.
- The course will increase and foster interdisciplinary research between students from different departments and industry partners and prepare for larger research ventures.

REQUIRED/OPTIONAL TEXTS

Parts of the following books and a selections of specific articles and papers are given as reading assignments and discussed in class:

- Bushan, Barat: Biomimetics: lessons from nature - an overview, in: Philosophical Transactions of Royal Society 367, 2009
- VDI (German Engineers Associations) Guidelines on Biomimetics
- Vincent, Julian F.V. et al.: Biomimetics – its practice and theory. Journal of the Royal Society Interface, 2006

COURSE GOALS/LEARNING OBJECTIVES

Objectives	Applicable Standards	Assignments/Assessments
Become familiar with biomimetics in an applied scenario setting	current literature	Attendance of the introduction lectures Reading responses Client meetings
Become familiar with biomimetics as a methodology	current literature	Analogy research, finding of biological role models, translation concepts
Interdisciplinary work in small teams	NA	Design project and prototype production
Become familiar with the other discipline's tools	NA	Research and presentation part of design project

COURSE CALENDAR

Week	Lecture	Studio/Design project
1	Introduction	Introduction phase
2	Background and task	
3	Methods and Tools in Biomimetics	Research and analysis phase
4	Special topics	
5	Concept presentation	Abstraction and concept phase
6	Studio - special topics	
7	Studio - special topics	
8	Studio - special topics	
9	Studio - special topics	
10	Midterm presentation	Intermediate design phase
11	Studio - review	
12	Studio - review	
13	Studio - review	
14	Studio - review	
15	Final presentation	Final research and project presentation

INSTRUCTIONAL STRATEGIES/ACTIVITIES

Activities included in the course are site visits, client interaction, lectures, guest lectures, field trips, basic research activities, studio work, reviews and presentations. Independent student work includes basic research on the role models, research in the field, libraries, biology and engineering labs, and contacting and requesting information from external organizations and experts. Production of prototypes and collaboration with the FabLab are envisioned.

TECHNOLOGY REQUIREMENTS

Basic computer equipment, optional photo/video equipment, drawing tools, optional 3D software, analog model making tools

EVALUATION/STUDENT ASSESSMENT/ATTENDANCE POLICY

The assessment of the course is 20% reading response and class activity, and 80% design project. Students are required to attend all class meetings. Students may not miss more than one week's worth of class time without penalty.

The following grade equivalencies apply:

A	93
A-	90
B+	87
B	83
B-	80
C+	77
C	73
C-	70
D+	67
D	63
D-	60
F	0

Submissions have to be met on time, and announced presentations have to be attended.

STUDENT ETHICS AND OTHER POLICY INFORMATION

Students at The University of Akron are responsible to know and abide by all university rules, regulations and policies. The Myers School of Art has a zero tolerance policy on theft, plagiarism and all forms of harassment, punishable by dismissal. Please review the Code of Student Conduct. <http://www.uakron.edu/studentconduct/code-of-conduct.dot>

In accordance with University policy, students with a documented disability for which accommodations may be required should contact the Office of Accessibility in Simmons Hall. Phone: 330-972-7928. E-mail: access@uakron.edu <http://www.uakron.edu/access>

The University of Akron is committed to providing an environment free of all forms of discrimination, including sexual violence and sexual harassment. This includes instances of attempted and/or completed sexual assault, domestic and dating violence, gender-based stalking, and sexual harassment. Additional information, resources, support and the University of Akron protocols for responding to sexual violence are available at uakron.edu/Title-IX.

BIBLIOGRAPHY

- Bhushan, Bharat. "Biomimetics: lessons from nature—an overview." (2009): 1445-1486.
- Bar-Cohen, Y. 2012. Biomimetics nature based innovation. CRC press.
- Cleymand, F., M. Rousseau, and J. F. Mano. 2015. Introducing biomimetic approaches to materials development and product design for engineering students. *Bioinspired Biomimetic and Nanobiomaterials* 4:207-212.
- Goel, A., G. Zhang, B. Wiltgen, Y. Zhang, S. Vattam, and J. Yen. 2015. The Design Study Library: Compiling, Analyzing and Using Biologically Inspired Design Case Studies. Pages 625-643 in J. S. Gero and S. Hanna, editors. *Design Computing and Cognition '14*. Springer International Publishing, Cham.
- Gruber, Petra. "Biomimetics in architecture: architecture of life and buildings". (2010) Wien: Springer.
- Hoeller, N., M. Farnsworth, S. Jacobs, J. Chirazi, T. Mead, A. Goel, and F. Salustri. 2016. A systems view of bio-inspiration: bridging the gaps. *Insight* 19:36-40.
- Imhof, Barbara, and Petra Gruber, eds. "Built to Grow-Blending Architecture and Biology." Birkhäuser, 2015.
- Myers, William. *Bio Design*. Museum of Modern Art, 2012.
- Naik, R. R., and S. Singamaneni. 2017. Introduction: Bioinspired and Biomimetic Materials. *Chemical Reviews* 117:12581-12583.
- Nathan, F. L., V. Paul, and J. P. Tony. 2013. The state of the art in biomimetics. *Bioinspiration & Biomimetics* 8:013001.
- Olga, S., S. David, H. Rafael, G. Johannes, and S. Klaus Peter. 2017. Biomimetic bio-inspired biomorph sustainable? An attempt to classify and clarify biology-derived technical developments. *Bioinspiration & Biomimetics* 12:011004.
- Raman, R., and R. Bashir. 2017. Biomimicry, Biofabrication, and Biohybrid Systems: The Emergence and Evolution of Biological Design. *Advanced Healthcare Materials* 6.
- Thompson, Darcy Wentworth. "On growth and form." *On growth and form*. (1942).
- Vincent, J. F. V. 2014. An Ontology of Biomimetics. Pages 269-285 in A. K. Goel, D. A. McAdams, and R. B. Stone, editors. *Biologically Inspired Design: Computational Methods and Tools*. Springer London, London.
- Vincent, J. F. V., O. A. Bogatyreva, N. R. Bogatyrev, A. Bowyer, and A.-K. Pahl. 2006. Biomimetics: its practice and theory. *Journal of The Royal Society Interface* 3:471-482.
- Whitesides, G. M. 2015. Bioinspiration: something for everyone. *Interface Focus* 5.
- Yen, J., M. Helms, A. Goel, C. Tovey, and M. Weissburg. 2014. Adaptive Evolution of Teaching Practices in Biologically Inspired Design. Pages 153-199 in A. K. Goel, D. A. McAdams, and R. B. Stone, editors. *Biologically Inspired Design: Computational Methods and Tools*. Springer London, London.

SIGNATURE PAGE

I have read and understand the policy/contract requirements for this course.

Course Subject, Catalog and Section Number: 3100:318 ST

Course Title: Biomimicry Design Challenge

Term/Year: Spring 2019

Instructor: Petra Gruber
