"Exploring Bio-Inspired Systems in Architecture" represents a unique opportunity for students to learn in a truly cross-disciplinary environment. It is being co-taught by an architecture professor (Associate Professor Marc Swackhamer) and a plant biology professor (Professor Neil Olszewski). This groundbreaking partnership between the College of Design, the College of Biological Sciences, and the Target Studio for Creative Collaboration at the Weisman Art Museum involves a four month calendar of uniquely combined educational and public activities. These include a final review of student work in the Weisman space, an evolving display of process work at key points in the course, a final exhibition of student projects, installation and exhibition of several pieces by bio-inspired artist, Jason Hackenworth, a showing of the film Second Nature: The Biomimicry Evolution, and a public lecture featuring many of the participants in the exhibition. The work will be curated in the Weisman by Visiting Curator, Matthew Groshek.

"Exploring Bio-Inspired Systems in Architecture" will examine the relationship between our natural and built environments. It will ask the question: what can biological systems teach us about how we design, construct, transport, market, maintain, use, and discard our built inhabitations? Throughout the semester, students will develop in-depth expertise in their chosen biology. Undertaking a process in which design and research organically merge, students will develop projects that perform like, rather than simply look like, biological systems. The course is organized around two hemispheres: the architectural and the biological, or, synthesis / response and research / speculation. Students will regularly oscillate between these hemispheres, allowing research to inform design work, and vice-versa.

Emphasis will be placed on unconventional thinking. This is an opportunity to question established architectural production methods and to think critically about the relationship between research and design process. It is also a chance to realize the potential impact of outside disciplines on architecture; in this case, biology. Along with continuous input from biology professor, Neil Olszewski, students will receive periodic feedback from other biologists, designers, engineers, and scientists through lectures and guest reviews. Deliverables by the end of the semester will include work that is drawn, modeled digitally and physically, diagrammed, and prototyped at full-scale. Additionally, a strategy will be developed for weaving individual projects together to communicate the networked solution suggested by their collective intelligence.
exploring bio-inspired systems in architecture
Arch8253 | syllabus | fall semester 2012 | mon, wed 1:00pm - 6:00pm

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Process Diagram:

01 define
one architectural/environmental problem to pursue
light / glare | spatial problem | acoustic | storage
lack of display | communication | color / ambiance | mechanical
organizational | resource | conservation | other

02 biologize
the problem by identifying 3 biological equivalents
cast a wide net / identify champions of problem:
database.portal.modwest.com / Bell Museum / library

03 research
the 3 biological precedents extensively
prepare a presentation of your research
develops preliminary diagram of your biologies
(visualized the information)

04 translate
5 biological systems into 5 architectural constructs
begin with diagram from collected bio research

05 select
1 bio system as most promising champion
greater depth of champion research

06 develop
your design scheme further based on new research
more extensive than previous proposal
focus on dynamic aspects of proposal

07 investigate
2 alternative functions of biological system
concept of “5-fold functionality”
what other tasks does bio system perform?

08 synthesize
new biological functions with project
speculates on part-to-whole relationship
how does “five-fold functionality” impact your scheme?

09 communicate
‘return to research with a keen eye for ‘hooks’
what could make an impression, make your idea
memorable and attach it to your biology /
develop a logo
‘tone the performance diagram
develop an elevator pitch

10 prototype
a fragment of your project at full scale
procure the materials and technologies necessary to
construct an isolated component of your project at
full scale
how does this new representation of your project
impact it overall, at the larger scale?

11 represent
your proposal clearly and completely
does your project challenge convention?
does it incorporate “5-fold-functionality”
does it stand up well against “biological principles”
does it perform like your biology, not just look like it?
can you communicate your idea clearly? (through both visual and verbal representation)
represent your project through multi, media & scales
(protoype it, model it, draw it, diagram it)

synthesis / response (detail / specificity)
general specific

research / speculation (depth)
detailed overview

lecture + workshop
handson workshop
introduction to biomimetics, bio-diversity, and evolution

FOR REVIEW

WK 01
WK 02
WK 03
WK 04
WK 05
WK 06
WK 07
WK 08
WK 09
WK 10
WK 11
WK 12
WK 13
WK 14
WK 15
exploring bio-inspired systems in architecture
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Schedule:

WEEK 01 OBJECTIVES:
Introduction to concepts behind biomimetics and examples of successful implementation of bio-mimetic design process through lectures, readings, and exercises. Identify your design problem.

Wed, Sep. 05: Syllabus overview course / syllabus overview
Introductory biomimicry workshop exercise to heighten observational skills
Assignment 01: DEFINE problem proposals (3 from each student)
Reading Assignment 01 Biomimicry ch. 1 (due Wed, Sep. 12)
assign reading discussion leaders schedule
SOA LECTURE | 6 pm | Rapson 100 Lola Sheppard | Lateral Office

WEEK 02 OBJECTIVES:
Identify three biological organisms (plant or animal) that address the problem you want to explore for the semester. Develop a nuanced understanding of your biology through extensive research. Develop preliminary diagrams for communicating and translating your research.

Mon, Sep. 10 Introduction to bio-mimetics introduction to bio-inspired processes / work that has emerged from it
Bio-diversity - Emilie Snell-Rood students present 3 problems - select one
Assignment 01: DEFINE due biologize the problem - key words?
Assignment 02: BIOLOGIZE identify 3 champions using biomimicry institute's database

Wed, Sep. 12 Evolution - Neil Olszewski overview of principles of evolution - lecture / discussion
Review Reading Asmnt 01 student led discussion
Reading Assignment 02 chapter from online publication Zygote (due Wed, Sep. 19)
Assignment 02: BIOLOGIZE due brainstorm as a group on adjustments that can be made to research
Assignment 03: RESEARCH present a nuanced understanding of your 3 chosen biologies
present research in the form of verbal description and visual diagrams

WEEK 03 OBJECTIVES:
Take first pass at exercise of translation from verbal / written research to visual design work. Understand multiple interpretations and possible scale variations of biomimetics – from material details, to wall assemblages, to full-scale buildings, to urban systems.

Mon, Sep. 17: Review of Assignment 03: RESEARCH presentation to outside reviewer(s)
Assignment 04: TRANSLATE present research from 3 biologies in form of diagrams / maps / animations
develop preliminary design responses (3) for Weds.
these should correspond with three researched biologies

Review Reading Assignment 02 Chapter from online publication Zygote
Assignment 03: RESEARCH AD - issue on biology (due Wed, Oct. 03)
informal pin-up #1 review first pass of design translations
scaled model (x3)
scaled drawings (x3)

FILM SCREENING | Weisman | 6:30 pm “Second Nature: The Biomimicry Evolution” + public discussion
WEEK 04 OBJECTIVES:

Hone and develop design response based on biological research. Improve this work incrementally through iteration and critical feedback. Push work forward through assessment of it as an architectural construct on its own, detached from its biological underpinnings.

Mon, Sep. 24: informal pin-up #12 review first pass of design translations scaled model (x3) scaled drawings (x3) diagrammatic explanation of translation strategy (x3) 

SOA LECTURE | 6 pm | Rapson 100 Rahul Mehrotra | GSD Chair + Professor | Principal, RMAarchitects

Wed, Sep. 26: Formal Review of Asmnt 04: TRANSLATE work reviewed by outside reviewers present 3 design schemes (one from ea. biological precedent) materials due: scaled model (x3) scaled drawings (x3) diagrammatic explanation of translation strategy (x3) 2-3 minute video diary explaining projects / process discuss how to narrow down to one “champion” Assignment 05: SELECT for Monday, choose one biology that you want to pursue further

*NOTE: At this point in the semester, some student work will be chosen for inclusion in round one of the exhibition at the Weisman’s Target Studio.

Fri, Sep. 28: SOA LECTURE | 6 pm | Rapson 100 William Chilton, FAIA RIBA | Principal, Pickard Chilton

WEEK 05 OBJECTIVES:

Develop research skills to deepen understanding and make new discoveries about your biological organism. Solicit feedback from those inside and outside the discipline of architecture on direction, clarity, appropriateness, and overall approach. Leverage this feedback to edit work, improve presentation quality, and sharpen thought process. Develop the technological sophistication of work.

Mon, Oct. 01: Review assignment 05: SELECT Assignment 06: DEVELOP informal presentation of one biology to research more deeply produce more developed versions of scheme models (digital and analog) + drawings new diagram of biology new diagram of design scheme - related to diag. of biology develop operable mechanisms

Wed, Oct. 03: Review Reading Assignment 03: AD - issue on biology Reading Assignment 04: Emergence Chapter 02 (due Wed, Oct. 17) Progress review small group reviews of Assignment 06 progress present new collected research - new discoveries produce multiple iterations explore scheme through multiple media

SOA LECTURE | 7 pm | Walker Cinema Eyal Weizman | Goldsmiths, Univ. of London, Prof. of Visual Culture + Director of Research Architecture

WEEK 06 OBJECTIVES:

Continue to develop work and deepen understanding of chosen biology.

Mon, Oct. 08: Progress review small team reviews of Assignment 06 progress present new collected research - new discoveries produce multiple iterations explore scheme through multiple media

Wed, Oct. 10: Review Assignment 06: DEVELOP materials due: overview of scheme (models / drawings) diagram of biology (w/ more depth) diagram of design scheme - related closely to bio diagram speculation on full-scale / operable mechanism Assignment 07: INVESTIGATE research “5-fold functionality” of biological component
WEEK 07 OBJECTIVES:
Understand biology more deeply than before through examination of other functions the biological component under scrutiny performs. Propose how a multi-functional approach to a design problem can begin to address peripheral problems in an unconventional / unexpected way. Begin to amplify the scale of your exploration - prototype your scheme instead of modeling it.

Mon, Oct. 15: Guest Lecture - AnnMarie Thomas  
Review assignment 07: INVESTIGATE 
Assignment 08: SYNTHESIZE

Wed, Oct. 17: Progress review
Review Reading Assignment 04: Emergence Chapter 02 
Reading Assignment 05: What Technology Wants - Ch. 1 (due Oct. 31)

WEEK 08 OBJECTIVES:
Continue to develop “Synthesize” exercise. Prepare for 2nd formal review / display at Weisman Target Studio.

Mon, Oct. 22: Progress review
SOA LECTURE | 6 pm | Rapson 100  
Makram El Kadi + Ziad Jamaleddine | L.E.F.T. Principals

Assignment 09: COMMUNICATE

WEEK 09 OBJECTIVES:
Communicate your project to non-architects. Consider how biology itself can serve to help explain and sell the idea, as well as how it might inform a logo and pitch for the project. At some point every architect needs to sell an idea. Develop the skill for clearly communicating your work without compromising its depth or richness.

Mon, Oct. 29 Progress review

*NOTE: This is the second of 3 points in the semester when student work will be chosen for inclusion in the exhibition at the Weisman's Target Studio.
Wed. Oct. 31: Progress review
Review Reading Assignment 05
Reading Assignment 06
small group reviews of Assignment 09 progress
What Technology Wants - Ch. 1
Chapter from online publication Zygote (due Wed, Nov. 07)

WEEK 10 OBJECTIVES:

Continue to develop “Communicate” exercise. Prepare for review.

Mon, Nov. 05: Progress review
SOA LECTURE | 6 pm | Rapson 100
Lindsay Bremner | Univ. of Westminster, Professor +
Director of Architectural Research

Wed, Nov. 07: Review assignment 09: COMMUNICATE
informal internal review (with potentially one other reviewer)
Assignment 10: PROTOTYPE
develop a full-scale prototype of your project
include any dynamic / responsive systems as part of your work
secure any advanced materials / circuits / mechanisms necessary
mechanism should be fully operable

WEEK 11 OBJECTIVES:

Understand how advanced materials / technology come together at full-scale to achieve the goals of your project. Carefully select a detail of your project that represents a particularly challenging intersection. Explore this detail through drawings, models, and full-scale prototypes. Communicate how this full-scale mock-up informs the larger composition of your project.

Mon, Nov. 12: Guest Lecture - Mithat Konar
Arduino programming / responsive systems
Progress review / workday
small team reviews of Assignment 10 progress

Wed, Nov. 14: Follow meeting - Mithat Konar
Progress review / workday
Arduino programming / responsive systems
small team reviews of Assignment 10 progress

WEEK 12 OBJECTIVES:

Continue to develop “Prototype” exercise. Prepare for review.

Mon, Nov. 19: progress review / workday
small team reviews of Assignment 10 progress

Wed, Nov. 21: Review assignment 10: PROTOTYPE
work reviewed by outside reviewers
Assignment 11: REPRESENT
materials due:
drawing / model of project indicating location of prototype
type prototype itself
diagram / animation of responsive system
does your project challenge convention?
does it incorporate “5-fold-functionality” (or at least 3)?
does it stand up well against “biological principals”?
does it perform like your bio sys, not just look like it?
can you communicate your idea clearly?
(through both visual and verbal representation)
represent your project through multi. media & scales
(prototype it, model it, draw it, diagram it)

WEEK 13 OBJECTIVES:

Frame proposal in relationship to a larger system, building, or assemblage. Speculate on where proposal might fit and how a change in this “cell” impacts the larger “organism.” Understand part-to-whole relationship, not only how prototype relates to larger project, but also how larger project might fold into a wider ecology.

Mon, Nov. 26: progress review / workday
small group reviews of Assignment 11 progress

Wed, Nov. 28: progress review / workday
small group reviews of Assignment 11 progress
WEEK 14 OBJECTIVES:

Develop project in preparation for final review.

Mon, Dec. 03: progress review / workday    small group reviews of Assignment 11 progress
Wed, Dec. 05: progress review / workday    small group reviews of Assignment 11 progress

WEEK 15 OBJECTIVES:

Develop project in preparation for final review.

Mon, Dec. 10: progress review / workday    small group reviews of Assignment 11 progress

Final Review
prepare succinct verbal presentation
max 5 minute presentation / person
Materials due:
- drawings (large and small scale w/ site context)
- models (both finished and study models)
- diagrams / animations (of biology as well as proposed system)
- full-scale prototype
- logo / marketing pitch
- images / research of biological precedent
- images / research of problem / site
- 2-3 minute video diary explaining projects / process

*NOTE: This is the third of 3 points in the semester when student work will be chosen for inclusion in the exhibition at the Weisman's Target Studio.

bibliography

www.biomimicry.net


What Technology Wants, Kevin Kelly


Techniques and Technologies in Morphogenetic Design (Architectural Design), Michael Hensel (Editor), Achim Menges (Editor), Michael Weinstock (Editor), John Wiley and Sons, 2006.

Emergence: Morphogenetic Design Strategies (Architectural Design), Michael Hensel (Editor), Achim Menges (Editor),
General studio policies:

Studio grades will be established primarily by performance in interim, mid-term and final reviews. Shown on the studio calendar are the dates for all reviews. Informal, in-class pin-ups will be part of every studio session, and all students are expected to participate and to come to studio prepared with work that addresses previous studio discussions. Some interim reviews will be attended by outside critics. The following criteria will be used to assess your work:

- depth of research
- development of work throughout semester
- personal improvement throughout semester
- responsiveness to criticism
- thoroughness
- clarity
- willingness to take risk
- quality and craft of presentations (visually and verbally)
- participation in class discussions
- attendance

Attendance is mandatory, unless you are ill or have an emergency. If you will not be attending class, please e-mail or call your instructor in advance. You will be deducted one-half letter grade for each unexcused absence. Work is due the day of reviews. All late work will be penalized 25% for each day it is past due (unless there are mitigating circumstances and you have pre-arranged a later due date with your instructor).

Subject to change:

With the exception of grade and attendance policies, parts of the syllabus are subject to change with advance notice, as deemed appropriate by the instructors.

Students with disabilities:

This syllabus can be made available in alternative formats upon request. Contact the Department of Architecture at (612) 624-7866.

Students with disabilities that limit their ability to fully participate in the class are encouraged to bring this to the attention of the instructor so that appropriate accommodations can be made. Further information is available from Disability Services, 16 Johnson Hall.

Scholastic conduct:

Students are responsible for conduct in conformance with the University of Minnesota Student Conduct Code which, among other provisions, broadly defines scholastic misconduct as "any act that violates the rights of another student in academic work or that involves misrepresentation of your own work."

Intellectual property:

The College of Design has the right to retain any student project whether it be for display, accreditation, documentation, or any other educational or legal purpose. In addition CDes reserves the right to reproduce and publish images of any such student work in collegiate publications, printed or electronic, for the purposes of research, scholarship, teaching, publicity and outreach, giving publication credit to the author.