

BIOLOGICALLY INSPIRED DESIGN
BIOL/ME/MSE/ISYE/PTFE 4740
 TuTh 135-255p, Cherry Emerson 320
COURSE SYLLABUS

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Office Hours:

Tuesdays 3:00-4:30

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Or meet by appointment.

Craig Tovey, Professor

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Rebecca Gray, Teaching Assistant

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Participating faculty and associates:

Marc Weissburg, Associate Professor, <http://www.biology.gatech.edu/faculty/marc-weissburg/index.php>

Dan Goldman, Assistant Professor, www.physics.gatech.edu/people/faculty/dgoldman.html

Ashok Goel, Associate Professor, home.cc.gatech.edu/dil/3

Michael Helms, Assisting Instructor; mhelms3@gatech.edu; <http://www.cc.gatech.edu/~mhelms3/>

Jason Nadler, Research Engineer, jason.nadler@gtri.gatech.edu

Bruce Walker, Associate Professor, <http://sonify.psych.gatech.edu/~walkerb/>

David Oakey, <http://www.davidoakeydesigns.com/>

Steve Vogel, <http://fds.duke.edu/db/aas/Biology/svogel>

All CBID faculty are facilitators: www.cbid.gatech.edu

Required text: **Vogel, S. 1998. Cat's Paws and Catapults.**

Highly recommended for this class:

Planet Earth, Blue Planet, Trials of Life, Microcosmos, Secret Weapons, Secret life of plants. Bulletproof Feathers.

Lecture Topics:

Lectures will cover the following biologically inspired topics:

- Locomotion
- Sensing/Photonics
- Hierarchical Structures and Biomaterials
- Complex Systems
- Green Solutions

Lesson Plan

Date/ WK	Lesson	Practice
08/24/10 08/26/10 ONE	Inspiration, Class Structure+ Goals. YEN Team formation; Planet Earth. SCOTT TURNER lecture: Wednesday Aug. 25, 4p, IBB Suddath Rm	CBID projects: overview Discussion with Scott Turner [lunch Th noon-130p Cherry Em 301a]
08/31/10 09/2/10 TWO	How to do Found Object exercises. WWH; How to investigate nature: Search strategies; Web of Science tutorial. YEN Evolution as designer WEISSBURG	Found Object: Critique; What, Why, How? YEN Design process, ideation (IDEO): Discuss overall project objectives
09/07/10, 09/09/10 THREE	Analogical reasoning / compound analogy, solution-based vs problem-based. GOEL Biology vs. human engineering, life's principles. WEISSBURG	Discussion of Analogy Assgt 1: Design and Intelligence Lab [DIL]/Yen
09/14/10, 09/16/10 FOUR	Biomaterials NADLER	Design and Intelligence Lab instructional Found Object: materials; 'support and protect'
09/21/10, 09/23/10 FIVE	Bio inspired Sensors/Photonics WALKER	Problem decomposition TOVEY/HELMS Found Object: 'sensing and moving' Yen/Walker
09/28/10, 09/30/10 SIX	Charrette ONE: Teams 1-4 YEN, HU, WEISSBURG, TOVEY and FACILITATORS	Charrette 1: Teams 5-8 YEN, HU, WEISSBURG, TOVEY and FACILITATORS
10/05/10, 10/07/10 SEVEN	Bio inspired Navigation WEISSBURG	Ecological Footprint and Environmental Impact Assessment [TOVEY] Problem definition
10/12/10, 10/14/10 EIGHT cat	Bio inspired locomotion GOLDMAN	Animal homes [YEN]
10/19/10, 10/21/10 NINE	School Holiday (Fall Break)	EIA of BID; team discussions DI Lab recap
10/26/10, 10/28/10 TEN	Sustainability: OAKLEY	Charrette 2: Posters presentations [must be ready to print by 5p Wed]:
11/02/10, 11/04/10 ELEVEN	Bio inspired Complex Systems / bio optimization TOVEY	EIA and Materials analysis of BID Team work: reframe problem; functional abstraction.
11/09/10, 11/11/10 TWELVE	Walk on Water HU	Capturing free energy VOGEL
11/16/10, 11/18/10 THIRTEEN	BID Quantitative Analysis critique : teams 1-4	BID QA critique : teams 5-8
11/23/10, 11/25/10 FOURTEEN	Team ClassWork: prepare Final Presentations. ALL	School Holiday (Thanksgiving)
11/30/10, 12/02/10 FIFTEEN	Final Presentations ALL	Final Presentations ALL
12/07/10, 12/09/10 SIXTEEN	Final Presentations ALL	Reflections Final discussion

Final papers due: 12/13/09

Final take home exam and idea journals due: 12/15/09

Grading

Idea Journal (10%)

Weekly journal entries reflecting insights from the week, spontaneous ideas, design concepts, interesting biological observations, interdisciplinary design team insights, etc. It will be turned in during the middle of the semester and at the end of the class for grading. Spot checks will be taken randomly.

Project Related Weekly Assignments (10%)

Individual Challenge Statements, Problem Descriptions, FO Biological Sources

Team Problem with Elaboration and Team Biological Analogies*

Materials analysis, Environmental impact assessment, Quantitative analyses*

20 Team References*

Design concepts (15%)

Design Concept 1*

Design Concept 2*

Design Concept 3*

Completing the weekly assignments will greatly minimize the amount of work the team is required to do for the final report, and allow the team to focus on depth of design. The final report will in essence be a revised version of all of the assignments marked with an asterisk(*).

Final Team Project: (40%)

- 1st presentation (5)
- Poster (5%)
- Final Presentation (10%).
- Final Portfolio (10%)
- Final Report (10%)
- Team/Peer Assessments (part of class participation)

The final portfolio will be 8 pages in length. The final design report should have evaluations of at least 5 biological systems, and must show understanding of and incorporate deep principles from at least one biological source. Minimally, 5 papers, preferably 10-15 should be cited with respect to the *biological systems evaluations*. The report should also cite at least 10 additional papers relevant to the *design space* being explored, either problem space or solution space (existing or new).

Take Home Final (10%): There are NO exams in this class.

Reflections over the course of the semester should be summarized in a 3-5 page document, graded on depth of insight.

Found Object Exercises and Class Participation (15%)

Each found object [FO] exercise will require a graded 1-2 page (single or double spaced) analysis of a physically-found object. These exercises will be related to our design challenge. There will be 3 found object exercises.

Attendance, in class participation (points for presenting), random collection of journals. During class students should demonstrate knowledge of readings, engage in lecture Q&A sessions, and participate actively in found object exercises and team design sessions. Students are being given time for in-class project work (charettes, critiques), where students are expected to be prepared and to engage with instructors. Student should not be afraid to try and test radical ideas and to, above all, have fun with their designs. *Class Participation fine print:* at the discretion of the instructors, deductions will be made to class participation scores for lack of preparation, reading/sending personal email in class, web surfing, texting, cell phone ringing (bonus deduction for really annoying ringtones), engaging in otherwise non-productive use of free class time or otherwise not having design-centered fun.