Integrative Biology 32
3 UNITS
Lower Division

BIO-INSPIRED DESIGN

Spring 2016

Instructors

Professor Robert Full
5128 VLSB
Office hours**:** Tuesday & Thursday. 1:30-2:30 PM
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GSI
One graduate student

Prerequisites: Open to all students.

Textbook: None: On Reserve, Vogel, Steven. *Cats' paws and catapults: Mechanical worlds of nature and people*. WW Norton & Company, 2000. Handbook of Biomimetics and Bioinspiration is available as an ebook - OskiCat link - http://oskicat.berkeley.edu/record=b21420375~S1

Design Kit: Zoob construction kits will be available at UCB Bookstore. There are 55-piece kits. Approximately $35.

bCourses Site:
We will use the IB 32 bCourses site for the syllabus, reading assignments, announcements, presentations and lecture material. You may access the site by going to:
https://bcourses.berkeley.edu, login through CalNet and then to Integbi 32

Meeting time and place: Tuesday & Thursday. 2040 VLSB. 11:00AM - 12:00PM

Discussion sections:
One hour per week
INTEGRATIVE BIOLOGY 32 S 101 DIS; Tu 12-1P, 3056 VALLEY LSB
Plus additonal as determined by class size.

Rationale: The goal of the course, Bioinspired Design, is to involve students in a interdisciplinary vision of biology, engineering and architecture by learning the principles of how animals and plants function in their environment. These design principles from Nature can be translated into novel devices and structures.

Bioinspired design views the process of how we learn from Nature as an innovation strategy translating principles of function, performance and aesthetics from biology to human technology. The creative design process is driven by interdisciplinary exchange among engineering, biology, art, architecture and business. Diverse teams of students will collaborate on, create and present original bioinspired design projects. Lectures discuss biomimicry, challenges of extracting principles from Nature, scaling, robustness, and entrepreneurship through cases studies highlighting robots that run, fly and swim, materials like gecko-inspired adhesives, artificial muscles, medical prosthetic devices and translation to start-ups.

Lecture topics include the process of bio-inspired design, copying Nature and biological constraints, the importance of scale, selecting organisms, design principles of sensors, muscle, and nervous system function, the mechanisms of swimming, crawling, running, and flying, as well as biological inspiration in medicine, robotics, computer animation, animatronics and design.

The goal of discussion section will be to conduct assignments to put the lecture mateiral into practice. Students will form teams of 5 or more in each discussion section based on different design challenges. Each team will conduct literature research for journal articles and books on their biological principle a d possible designs that will provide information beyond what was learned in class.

At the end of the course, students will produce novel designs using inspiration from the principles learned throughout the semester. Each Design Team (4 or 5 students) will build a prototype and give a 10 minute poster presentation on their models and research as if they were presenting their ideas and designs to a support source.

The poster presentations will be held during two classes we will call "Bioinventor Presentations". Design Teams are responsible for making a poster explaining their design. Each design team will give a 10 min presentation of the poster and design to the "Program Funding Officials" (Prof. Full and the GSIs). Individuals of each design team are also responsible for evaluating the competitors' designs and must hand in evaluations at the end of the session.

Approximately 10 posters will be displayed in two Bioinventor Class Presentation Periods. One half of the Design Teams will remain at their poster from half the class, while the other half are free to question and evaluate them. At haf way throught the class the Design Teams will switch places - the evaluating design teams will return to their posters and the presenting teams will begin evaluation.

Grading

1. Midterm Exam: 30% of total grade
2. Design Presentations:
   30% of total grade. Design teams will present their designs at a Poster Symposium and provide questions/evaluations of the design of others.
3. Final Exam: 40% of total grade

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TENTATIVE COURSE SCHEDULE, Spring 2016

19 January	1. Introduction to the course
21 January	2. What is Bio-inspired Design? The Process
26 January	3. Approaches to Selecting Organism
28 January	4. Taming Complexity of Biological Systems
2 February	5. Appropriate Scale?
4 February	6. Copy Nature? Design Constraints in Organisms
	Materials
9 February	7. Muscles: Are muscles better than motors?
11 February	8. Artificial muscles
16 February	9. How can Geckos climb on glass?
18 February	10. Dry adhesion
	Sensors
23 February	11. Biological sensors
25 February	12. Bio-inspired sensors

	Control
1 March	13. **Midterm**
3 March	14. Neural control
8 March	15. Robot controllers
10 March	16. Running
15 March	17. Robustness
17 March	18. Crawling - Soft robotics
22 March	Spring Vacation
24 March	Spring Vacation
29 March	19. Gliding & Flapping flight - Bees can't fly
31 March	20. Swimming – Dolphins can't swim
5 April	21. Arcitecture – Guest Lecture
7 April	22. Design Process - Guest Lecture
12 April	23. Entrepreneurship
14 April	24. Team Design Project Preparation
19 April	25. Team Design Project Preparation
21 April	26. Bioinventor's Presentations
26 April	27. Bioinventor's Presentations
28 April	28. Summary
18 May	**Final exam** 8-11AM (group 13) Wednesday