Integrative Biology 135
MECHANICS OF ORGANISMS
SPRING 2024
Control Number: **31073**

TENTATIVE SYLLABUS

Instructors

Professor Robert Dudley
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Professor Robert Full
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Graduate student instructor
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Lectures: TuTh 11:00AM-12:30PM; 125 – Li Ka Shing
All lectures will be **in-person**. Access will be through bCourses. We will make every effort to post PDFs the day before the scheduled lecture date in Files Folder / Lectures and they will remain available.

Required Text: Comparative Biomechanics: Life's Physical World - 1st Edition by Steven Vogel (SV) on bCourses. Nature's Machines: An Introduction to Organismal Biomechanics 1st Edition by David E. Alexander (DA). Free online and on bCourses.

Rationale:
The same physical **principles** apply to any structure, whether biological or human-made. Much can be learned about organisms by considering their structure and function in terms of basic mechanical rules. During this course, some basic fluid and solid mechanics will be presented along with numerous examples of their biological consequences. We'll consider how organisms interact with their **physical environments** and explore how the **mechanical behavior of organisms** depends on their structure at various levels of organization, ranging from molecules to tissues to whole-body construction. We'll analyze various modes of locomotion (walking, running, swimming, flying), muscle mechanics, stability and control, and efficiency. We will deal with **humans** and with other types of **organisms** that have been useful model systems for biomechanical research. The purpose of this course is to introduce you to the breadth of diverse topics within the field of biomechanics.

Social Mixer Gallery to Facilitate Teaming:

In this class, you will form teams that will deliver Symposium Presentations on a research publication of your choice. We propose to create a Group Slide Gallery containing information about you so that you can get to know your classmates in your team. On one PowerPoint Slide (.pptx), you will introduce yourself to your classmates with pictures, preferences, and your expertise. Of course, your participation is optional. You need not add all the requested

information. Practically, we hope this will facilitate teaming for the symposium presentations later in the semester.

Grading:

1. **Lecture Assignments.** Each lecture will be accompanied by a bCourses Assignment with two questions and a request to add one citation that will be due on Fridays. After the lecture, select a single **concept** and/or **principle** that was new to you and caught your interest. Please explain it as a text submission to this assignment (250 words max). The second part is a **lecture question** that will direct you to a Google form where you will enter your name, discussion section, and any question that you have about the lecture. We will answer your questions in subsequent discussion sections (250 words max). Please add one citation from the literature to the Google Form that broadly relates to the lecture. There is no best choice, just one that interests you. Use standard reference formatting (e.g., Glazier, Douglas S. "Complications with body-size correction in comparative biology: possible solutions and an appeal for new approaches." *Journal of Experimental Biology* 225.Suppl_1 (2022): jeb243313.)

2. **Exams.** Mid-term and Final Exams will cover material from the lectures. They will consist of you selecting a scientific publication. Your exams will NOT be the typical one to three-hour proctored exams. We have designed a new, far less stressful, and more representative exam. You will be given 7 days to complete the midterm exam and 7 days to complete the final exam. Exams will consist of you selecting scientific publications, telling us how the discovery uses the concepts learned in class, and using these concepts to interpret data in plots and tables.

    - **Midterm Exam:** Midterm exam paper selection is due February 13. Midterm exam will be given on February 20 and due February 27. Will be 30% of the total grade. It will cover lecture material from January 16 through and including February 20 and discussion section material through February 14. You will have one week to submit the midterm exam as an Assignment.
    - **Final Exam**: Final exam paper selection is due April 18. Final exam will be given on April 25 and due 11:00AM on May 9, the exam will be 30% of the total grade. You will have two weeks to submit the final exam as an Assignment. The final exam will be like the midterm exam but covering lecture material from February 20 through the end of the course and discussion section material from February 21 through the end of the course. You will select a research paper related to the second half material.

3. **Team Presentation**. A team presentation in a symposium format is required. Given in the second half of the semester, it will be 30% of the total grade. You will form teams of 2-3 students, select a research publication on a physiological discovery, "become" the authors, and give a 20 min presentation using PowerPoint. Teams will first provide a general background, discuss the methods and results, and then critically evaluate the conclusions. The presentation will end by asking what appropriate next steps might be and where the field is going overall. All other groups will then ask questions to the team in class.

Final Grade. Your final grade will be determined in the following way:

10%: (60 pts. 3 pts. each) Lecture Assignments - a reflection, a question, and a citation on the lecture (20 assignments).
30%: (200 pts.) Midterm exam
30%: (200 pts.) Final exam
25%: (167 pts.) Team Presentations
5%: (33 pts.) Questions to Team Presenting

660 possible points. Final grades are based both on an absolute scale as well as a curve, along with potential positive effort adjustments. Our absolute scale is approximately 100-80 A; 80-70 B; 70-60 C; 60-50 D; <50 F (including + and -). Curve – In the unlikely event that grading shows that the absolute scale is too high, we will lower the curve. We will not raise it to make it more difficult to get a grade. At the end of the semester, we will all meet to discuss any student who is in the gray zone between grades. If you have shown effort, engagement, and improvement, you will receive the next higher grade. We will not pull down a student to a lower grade.

Disabled Students:
If you have a disability, or think you may have a disability, you can work with the Disabled Students' Program ('DSP') to request an official accommodation. DSP is the campus office responsible for authorizing disability-related academic accommodations, in cooperation with the students themselves and their instructors. You can find more information about DSP, including contact information and the application process at http://dsp.berkeley.edu.

Discussion Sections:
We will have in-person Discussions at the regularly scheduled times on Wednesday. We will present material and answer your questions. Material covered in discussion sections will complement and expand upon topics introduced in lecture. Specific examples of general principles will be discussed, opportunities for review of lecture and reading material will be provided, and sample problems will be worked on. We will discuss the questions you submitted for the lecture Assignments. In the second half of the semester, time will be provided to work on your in-class presentations.

Course: INTEGRATIVE BIOLOGY 135 S 101 DIS
Location: Wed 2-3P, 3059 - VLSB
Course Control Number: 31074

Ed Discussion (EdD) - Online Discussion Forum:
We will use Ed Discussion (EdD) as our online forum. EdD is a venue to ask questions, discuss problems, and help each other out. EdD is a question-and-answer system designed to streamline class discussion outside of the classroom. It should always be your first recourse for seeking answers to your questions about the course, lecture or reading material, or the assignments. You are encouraged to post any questions you might have about the course material, logistics, and assignments. Please post questions about the material or the administration of the course to the discussion board - but before posting a question, read the discussion board and the syllabus and other course materials in case the question has already been answered. If you know the answer to a question, you are encouraged to post it. By default, your posts are visible to the course staff and other students, and you should prefer this mode so that others can benefit from your question and the answer. We will monitor the discussion board, endorse answers, and reply. You can post privately so that only the course staff can see your question. If you post privately, we reserve the right to make your question public if we think the class will benefit. You can also post anonymously if you wish. Do not post your SID on EdD. Please avoid email if EdD will do. Posts may be anonymous to the class, but not to the instructor. We expect that posts will be pertinent and respectful. Don't use EdD as a place to complain about, insult or harass anyone. Please do send us email if you have a real emergency or need to discuss something privately.

Web Site:
We will use a 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.

INTEGRATIVE BIOLOGY 135

MECHANICS OF ORGANISMS

TENTATIVE LECTURE & DISCUSSION SCHEDULE, Spring 2024

Tuesday & Thursday, 11:00AM - 12:30PM

Date	Lecture	Discussion	Readings
16 Jan	**1. Introduction**		SV Ch. 1-2,4; DA Ch.1
17 Jan		1. Intros & Searching	
18 Jan	**2. Size and scaling**		SV Ch.3; DA Ch.5
23 Jan	**3. Introduction to solid mechanics: stress and strain**		SV Ch.15; DA Ch. 2.1–2.3
24 Jan		2. Searching & Allometry	
25 Jan	**4. Bending, buckling, twisting, kinking - design of skeletal elements**		SV Ch.18-21 DA Ch. 2.4
30 Jan	**5. Biological composite materials, fracture, safety factor, viscoelasticity**		SV Ch.16-17; DA Ch.4
31 Jan		3. Stress/Strain & Skeletal Design Questions	
1 Feb	**6. Muscle mechanics - nanomotors**		SV Ch.22
6 Feb	**7. Muscle mechanics – material properties**		SV Ch.23
7 Feb		4. Biomaterials & Muscle Questions	
8 Feb	**8. Mechanics of walking and running**		SV Ch.24; DA Ch.5
13 Feb	**9. Efficiency of locomotion**		See Readings
14 Feb		5. Muscle &Terrestrial Locomotion Questions	
15 Feb	**10. Surface properties and adhesion**		SV Ch.21
20 Feb	**11. Introduction to fluids and biological plumbing systems**		SV Ch.5
21 Feb		6. Efficiency & Adhesion Midterm Assistance	
22 Feb	**12. Laminar vs. turbulent flow, Reynolds number**		SV Ch.6
27 Feb	**MIDTERM EXAM – No Class**		
28 Feb		7. Fluid & Flow Questions	
29 Feb	**13. Life at low Reynolds number (the fluid world small organisms)**		SV Ch.11
5 Mar	**14. Boundary layers, flow microhabitats, mass exchange, unsteady environmental flow**		SV Ch.8 DA Ch. 3.3
6 Mar		8. Re Questions	
7 Mar	**15. Drag at high Reynolds number**		SV Ch.7
12 Mar	**16. Features that influence form drag**		
13 Mar		9. Layers & Drag Questior	
14 Mar	**17. Parachuting, gliding, and other uplifting subjects**		SV Ch.12 DA Ch. 3.4
19 Mar	**18. Flying and swimming – quasi-steady-state approach**		SV Ch.13 DA Ch. 3.5
20 Mar		10. Swim & Fly Questions	
21 Mar	**19. Non-steady-state flying and swimming; locomotion at the air-water interface**		SV Ch.14 DA Ch. 3.7
26 Mar	**Spring Break**		
27 Mar	**Spring Break**		
28 Mar	**Spring Break**		
2 Apr	**20. Presentations**		
3 Apr		11. Questions & Presentation Assistance	
4 Apr	**21. Presentations**		
9 Apr	**22. Presentations**		
10 Apr		12. Questions & Presentation Assistance	
11 Apr	**23. Presentations**		
16 Apr	**24. Presentations**		
17 Apr		13. Questions & Presentation Assistance; Final Exam Assistance	
18 Apr	**25. Presentations**		
23 Apr	**26. Presentations**		
24 Apr		14. Final Exam Assistance	
25 Apr	**27. Summary**		
9 May	**FINAL EXAM**		

Assistance, Policies & Conduct

General Support Availability Announcement
We pledge to make your experience this semester worth your effort.

A Perspective on Course Redesign for All. We can't imagine all the challenges and inequities you might have been and still be experiencing. It is your course and we are here to help. Please do not hesitate to alert us to any issues beyond the course that you have with housing or food security, physical and mental health, connectivity, or safety. Do not feel embarrassed to ask for help. Remember that seeking help is a courageous thing to do—for yourself and for those who care about you.

We recommendation the use of Berkeley's New Support Portal. "Supportal" is a single entry point for all UC Berkeley community members to find support for themselves or others about a variety of concerns.

Academic Accommodations Hub. This site provides support resources and academic accommodations to ensure all students have a fair chance at academic success. https://evcp.berkeley.edu/programs-resources/academic-accommodations-hub

Inclusion: We are committed to creating an environment welcoming of all students where everyone can fulfill their potential for learning. To do so, we intend to support a diversity of perspectives and experiences and respect each other's identities and backgrounds (including race/ethnicity, nationality, gender identity, socioeconomic class, sexual orientation, language, religion, ability, etc.). If you need accommodations that provide equitable access, (e.g., religious observance, physical or mental health concerns, insufficient resources, etc.) please check https://diversity.berkeley.edu/. If you have a name and/or pronouns that differ from your legal name, designate a preferred name for use in the classroom at: https://registrar.berkeley.edu/academic-records/your-name-records-rosters. As a participant in this class, please recognize that you can be proactive about making other students feel included and respected.

Resources & Support for Sexual Harassment and Assault: The University of California is committed to creating and maintaining a community where all individuals who participate in University programs and activities can work and learn together in an environment free of harassment, exploitation, or intimidation. Sexual harassment and violence are prohibited both by law and by University of California policy. Sexual harassment is defined as unwelcome sexual advances; requests for sexual favors; and other verbal, nonverbal or physical contact of a sexual nature. Sexual harassment includes conduct that explicitly or implicitly affects a person's employment or education or interferes with a person's work or educational performance or creates an environment such that a reasonable person would find the conduct intimidating, hostile or offensive. Sexual harassment includes sexual violence. https://supportal.berkeley.edu/i-am-seeking-help/harm-and-misconduct/sexual-violence-harassment

Disabled Student's Program (DSP 260 César Chávez Student Center #4250; 510-642-0518). DSP serves students with disabilities of all kinds, including temporary disabilities.
https://dsp.berkeley.edu/students

Grading & Exam Format and Proctoring. We have participated in UC Berkeley's Grading for Equity - Promoting Excellence in All Students Through Equitable Grading and Assessment

Workshop Series. As a result, we have redesigned our course assignments to reduce stress, eliminate proctoring, be as fair as possible, and even enhance your learning experience.

The student community at UC Berkeley has adopted the following Honor Code. "As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others." The expectation is that you will adhere to this code, as your instructors pledge to do as well. For more information, please visit this website: https://teaching.berkeley.edu/berkeley-honor-code

Policy on UC Berkeley's Code of Student Conduct. All students are expected to follow the University of California at Berkeley's Campus Code of Student Conduct, as is published at https://ethics.berkeley.edu/code-conduct. Cheating, plagiarism, or any other form of academic dishonesty will not be tolerated (102.01).

Policy on plagiarism. In academia ideas are our commodity. Taking direct text or ideas or data or results from someone else's work without properly giving credit is essentially stealing. Representing them as your own is unethical and disrespectful. This is unacceptable in a university and we take it very seriously here at UC Berkeley. We will pursue disciplinary action against students who plagiarize in this class.

Policy on accommodation of religious holidays and other scheduling conflicts: In compliance with Education code, Section 92640(a), it is the official policy of the University of California at Berkeley to permit any student to undergo a test or examination, without penalty, at a time when that activity would not violate the student's religious creed, unless administering the examination at an alternative time would impose an undue hardship which could not reasonably have been avoided. All deadlines and the midterm exam date (Oct. 11) are noted on this syllabus. It is your responsibility to note any conflicts with the exam and due dates and let the instructor and GSIs know. If you have other scheduling conflicts, please see the guidelines at: https://teaching.berkeley.edu/checklist-scheduling-conflicts-academic-requirements

Policy on exams, lecture, and design assignments due dates. We will have due dates for all assignments. Keeping pace is in your best interest, because material builds on that all comes before. Given challenging circumstances and the inequities present, we will be as flexible as possible with due dates. If you do find yourself facing an unforeseen circumstance, please contact us as soon as possible to let us know.

Policy on students with learning disabilities. Disabled students please make certain that your communication from the Disabled Students Program is sent to us as soon as possible. See http://dsp.berkeley.edu

Policy on recording lectures or selling slides or notes. Posting or selling video recordings are expressly prohibited by University of California policy. Lectures are comprised of copyrighted intellectual material, and the recording and sharing of that material without express permission is a violation of copyright and personal privacy. Additionally, the discussion of sensitive issues in this class requires that students feel safe to express their opinions without fear of future reprisal or exposure. Note, it is a violation of copyright to sell notes, assignments or exams to on-line companies.

Land Acknowledgement (https://cejce.berkeley.edu/ohloneland)