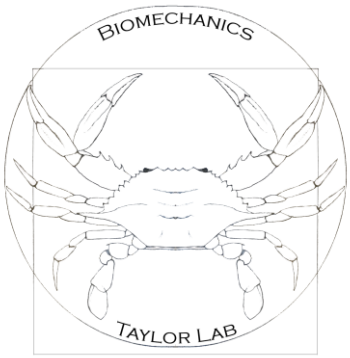
SIO 125: Biomechanics of Marine Life

Spring 2020



Instructor: Jennifer Taylor, Ph.D.
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Office Hours: Skype/Zoom/Facetime by appointment (Skype name: jratay)

Lectures: Tuesday/Thursday 2:00-3:15 Pacific Time

Zoom Information: Lectures will be held live via Zoom during the scheduled lecture time. Recordings of lectures will be available a few hours later on Canvas.

Meeting ID: 640-719-422
Join URL: https://ucsd.zoom.us/j/640719422

Canvas: All assignments, exams, grading, and announcements will be through the course Canvas site.

Software: Please download free software to scan and upload your problem sets and exams as PDFs to Canvas. There are many options that you can install on your iphone or android device, such as:
GeniusScan (https://thegrizzlylabs.com/genius-scan)
Adobescan (https://acrobat.adobe.com/us/en/mobile/scanner-app.html)
Camscanner (https://www.camscanner.com/)
Also, the Notes app on Iphone, or equivalent for android, will work

Course Objectives:

The main goal of this course is to develop an understanding of the fundamental connection between the physical and biological worlds. This course explores how the physical principles of solids and fluids underlay the functional morphology, ecology, and adaptations of all living things, with emphasis on marine organisms. Specifically, this course explores the forces on organisms such as the mechanical forces from flows, hydrostatic pressures, impacts, and gravity, and how the shapes, habits, and materials of organisms reflect these forces.

By the end of this course, you should be able to**:**

- Describe the properties of biological materials
- Explain how organism body parts respond to external forces
- Explain how structural support systems of organisms work
- Describe the laws of static and flowing fluids
- Explain how the physics of fluids govern support in organisms
- Explain how animals move through fluids

Textbook:

Required: Vogel, S. 2013. *Comparative Biomechanics: Life's Physical World.* Second Edition, Princeton University Press, 580 pp. (first edition and e-books are acceptable)

Course Requirements:

Field trips: Sadly, none of the awesome field trips will be offered this quarter. ☹ IF I am able to reschedule the 1 day cruise aboard the *RV Gordon Sproul* for the summer and you are interested in going, you can let me know. This would be just for fun.

Exams: There will be one mid-term exam covering solid mechanics and one non-comprehensive final exam covering fluid mechanics. Exam format includes problem solving and short answer questions. The exams will be "open-book" and "open-notes", as they are designed to test your application of concepts and not memorization of facts and formulas. Internet resources are off limits. You may only use your textbook and lecture notes to complete the exam. If you fail to abide by this rule, you will receive a zero for the exam.

Exams will be posted on Canvas at the start of lecture and you will work on them during the scheduled Zoom lecture. This will enable me to answer questions immediately for the entire class. Following the Zoom lecture time, **completed exams should be uploaded as a single PDF in Canvas**. If you are in a different time zone for which this will be difficult, please let me know ahead of time.

Problems Sets: Throughout the quarter you will be given 4 problem sets to complete as homework. Each problem set will consist of several questions that require you to apply the concepts covered in lecture and will include calculations and written answers. They will be similar to the exams, but sometimes more in depth and challenging. You will have 1 week to complete each problem set. Completed problem sets should be **uploaded as a single PDF in Canvas** prior to lecture on the due date. The problem sets must be completed independently, without any assistance from your classmates or others. If you fail to abide by this rule, you will not receive credit for the homework.

Attendance: It is extremely helpful if you participate in the live Zoom lectures. Usually this course is very interactive, with questions flowing both ways. If it is not possible for you to participate, recorded lectures will be available and you can email me with questions. Email is not optimal for complex or lengthy questions, so I encourage scheduling a virtual meeting to handle those. Lectures are given on the whiteboard so there will be no powerpoints or lecture notes available. Lecture content will be the main source of material for exams and problem sets and the textbook serves as an important supplementary resource. Keeping up with the lectures is critical for succeeding in this course.

Grading:

Exams	2 x 100 Points	200
Problem Sets	4 x 50 Points	200
Total		**400 Points**

Grading Scale:

≥ 97 %, 93-96, 90-92	A+, A, A-
87-89, 83-86, 80-82	B+, B, B-
77-79, 73-76, 70-72	C+, C, C-
67-69, 63-66, 60-62	D+, D, D-
≤ 59	F

Tentative Lecture Schedule: We will likely deviate from the schedule below.

Date		Lecture Topic	Text Chapter
March 31	Tue	Introduction, lecture troubleshooting	
April 2	Thu	The basics- dimensions, units, force, and scaling	Appx 1-3
Part I: Solid Mechanics			
7	Tue	Solids – properties of materials	15
9	Thu	Cont.	
14	Tue	Biological materials *Problem Set 1*	16
16	Thu	Complex materials – composites	17
21	Tue	Cont. *Problem Set 1 Due*	
23	Thu	Complex materials – viscoelasticity	18
28	Tue	Structures – beams and columns *Problem Set 2*	19
30	Thu	Structures – complex, hydrostatic	20,21
May 5	Tue	Cont. *Problem Set 2 Due*	
7	Thu	**Exam 1 (Solids), 2:00-3:30 Pacific Time**	
Part II: Fluid Mechanics			
12	Tue	Resting fluids	4
14	Thu	Air-water interface	5
19	Tue	Flowing fluids *Problem Set 3*	6
21	Thu	Cont.	
26	Tue	Forces of flow *Problem Set 3 Due*	7
28	Thu	Moving in fluids – lift *Problem Set 4*	12
June 2	Tue	Moving in fluids – Thrust	13
4	Thu	Ecomechanics *Problem Set 4 Due*	
June 9	**Tue**	**Exam 2 (Final Exam, Fluids- non-cumulative), 3:00-6:00 pm Pacific time**	