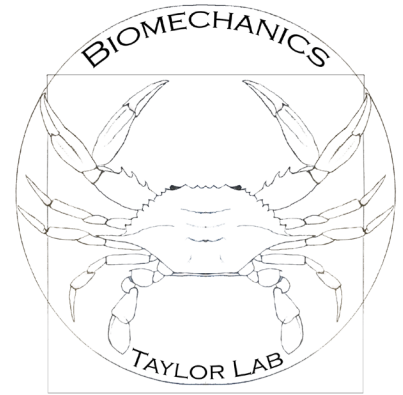


# SIO 125: Biomechanics of Marine Life

Spring 2021



**Instructor:** Jennifer Taylor, Ph.D.  
Associate Professor, Marine Biology Research Division, SIO  
email: j3taylor@ucsd.edu

**Office Hours:** After class or by Zoom appointment

**Lectures:** **In person only**  
Warren Lecture Hall (WHL) 2005  
Tuesday/Thursday 2:00-3:20

**Canvas:** Assignments, grading and announcements will be available through the course Canvas site.

## 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:** Due to pandemic restrictions, we will only have one field trip this quarter. This trip will be to the Scripps tidepools and sandy beach, where we will explore the physical aspects of these environments and the mechanical adaptations of organisms that live there. The field trip will take place during the scheduled lecture time, or independently if necessary. An accompanying assignment will be required. Please note the schedule below.

**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. Exam answers should be written on notebook paper, with questions numbered and pages stapled together.

**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. Problem set answers should be written on notebook paper (typed or printed legibly), with questions numbered and pages stapled together. They are due at the start of 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 to your advantage to attend lecture on a regular basis. Usually this course is very interactive, with lots of questions and discussion. Lectures are given on the whiteboard so there will be no powerpoint slides 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
Field Trip	1 x 25 Points	25
<b>Total</b>		<b>425 Points</b>

**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 30	Tue	Introduction, The basics- dimensions, units, force, and scaling	Appx 1-3
<b>Part I: Solid Mechanics</b>			
April 1	Thu	Solids – properties of materials	15
6	Tue	Cont.	
8	Thu	Biological materials <i>Problem Set 1</i>	16
13	Tue	Complex materials – composites	17
15	Thu	Cont. <i>Problem Set 1 Due</i>	
20	Tue	Complex materials – viscoelasticity	18
22	Thu	<b>Field Trip:</b> Scripps tidepools and sandy beach <i>Problem Set 2</i>	
27	Tue	Structures – beams and columns	19
29	Thu	Structures – complex, hydrostatic <i>Problem Set 2 Due</i>	20,21
May 4	Tue	Cont. and review	
6	Thu	<b>Exam 1 (Solids), 2:00-3:20</b>	
<b>Part II: Fluid Mechanics</b>			
11	Tue	Resting fluids	4
13	Thu	Air-water interface	5
18	Tue	Flowing fluids <i>Problem Set 3</i>	6
20	Thu	Cont.	
25	Tue	Forces of flow <i>Problem Set 3 Due</i>	7
27	Thu	Moving in fluids – lift <i>Problem Set 4</i>	12
June 1	Tue	Moving in fluids – Thrust	13
3	Thu	Cont. and review <i>Problem Set 4 Due</i>	
<b>June 8</b>	<b>Tue</b>	<b>Exam 2 (Final Exam, Fluids- non-cumulative), 3:00-6:00 pm</b>	