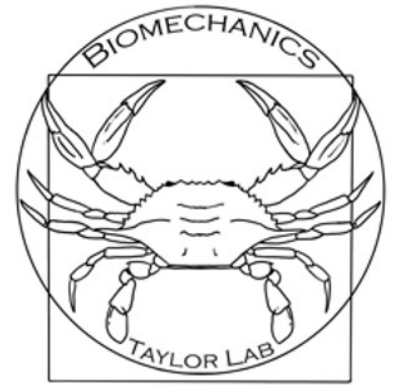


# SIO 125: Biomechanics of Marine Life

Spring 2022



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

**Lectures:** **In person only**  
Eckart 236  
Tuesday/Thursday 9:30-10:50

## 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 and how to test them
- Explain how organism body parts respond to external forces
- Explain how structural support systems work
- Describe the laws of static and flowing fluids
- Explain how the physics of fluids provide support in organisms
- Explain how animals move through fluids
- Apply physical principles to the daily life of organisms

## 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)

## Canvas:

Assignments, grading and announcements will be available through the course Canvas site. Note that there will be no powerpoint or lecture recordings available.

## Course Requirements:

### Field Trips:

There will be 2 required class field trips during the quarter, each with an assignment. Please note the dates in the schedule below. An alternate assignment will be available for those who cannot attend. One of these trips is to the Scripps tidepools and will take place during the scheduled lecture time, while the other is a day-long cruise aboard the Scripps research vessel *Gordon Sproul*. This cruise will take place on **Saturday, April 16** and will be all day, from 6:00 am to 10:00pm. Detailed information will be provided.

- *Deep Sea, R/V Gordon Sproul cruise*
  - Explore the morphology of animals collected from deep sea benthic and pelagic environments while gaining at-sea experience and learning the instrumentation used to study animals from these remote habitats.
- *Scripps tidepools and sandy beach*
  - Explore the physical aspects of these environments and the mechanical adaptations of organisms that live there.

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 understanding and 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. Failure to abide by this rule is a violation of academic integrity (see below), meaning that you will receive a zero for the exam and be reported to the Academic Integrity Office. Exam answers should be written legibly on lined paper, with questions numbered and pages stapled together.

There are no make-up examinations. Individual circumstances will be evaluated at instructor's discretion.

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 to real life scenarios. They will be similar to exams, but generally more in-depth and challenging. You will have 1 week to complete each problem set. Problem set answers should be written legibly on lined paper or typed, with questions numbered and pages stapled together. Problem sets 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. You may use your notes and textbooks only. Failure to abide by this rule is a violation of academic integrity (see below), meaning that you will receive a zero for the problem set and be reported to the Academic Integrity Office

**Attendance:** It is to your advantage to attend lecture on a regular basis. This course is interactive, with the expectation that you will participate in questions and discussion. Lectures are given on the whiteboard so there will be no powerpoint slides or lecture notes available. If you miss class, please reach out to other students to catch up on what you missed. 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 Trips	2 x 25 Points	50
<b>Total</b>		<b>450 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

## Academic Integrity

To get the best learning experience from this course, students are expected to do their own work on all exams and problem sets, without the assistance of others or unapproved resources, including the internet. Discussing exam or problem sets with others or copying/sharing any part of a problem set or exam constitutes a violation of academic integrity. Such actions will result in a failing grade for that assignment and will be reported to the Academic Integrity Office, which may impose further sanctions. Sanctions can include an F in this class and suspension or dismissal from the University ([academicintegrity.ucsd.edu](http://academicintegrity.ucsd.edu)). If you have any questions or need clarification, please reach out to me.

## Campus resources

**Mental health:** Counseling and Psychological Services (CAPS) provides free, confidential psychological counseling and crisis services for all registered UC San Diego students. CAPS can help if you are experiencing academic distress, depression, anxiety, sleep problems, or other issues.

To contact CAPS, call (858) 534-3755. All students are screened with a brief telephone assessment. For more information and self-help resources, visit <https://caps.ucsd.edu>.

**Sexual violence:** If you experience sexual violence or gender-based violence (dating violence, domestic violence, stalking), CARE at the Sexual Assault Resource Center can provide you with *confidential* help. CARE Response is available 24/7 for UCSD students in need of urgent support, assistance with reporting options, forensic exam information and accompaniment, and crisis counseling. ([care.ucsd.edu](http://care.ucsd.edu)). **Location:** Student Services Center, 5th floor, Suite 500

Confidential counselors are available 24/7 **CARE hotline: 858-534-5793**

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

Date		Lecture Topic	Text Chapter
March 29	Tue	Introduction, The basics- dimensions, units, force, and scaling	Appx 1-3
<b>Part I: Solid Mechanics</b>			
31	Thu	Solids – properties of materials	15
April 5	Tue	Cont.	
7	Thu	Biological materials <i>Problem Set 1</i>	16
12	Tue	Complex materials – composites	17
14	Thu	Intro to the deep sea <i>Problem Set 1 Due</i>	
<b>16</b>	<b>Sat</b>	<b>Field Trip: Research Cruise</b>	
19	Tue	Complex materials – viscoelasticity	18
<b>21</b>	<b>Thu</b>	<b>Field Trip: Scripps tidepools and sandy beach</b> <i>Problem Set 2</i>	
26	Tue	Structures – beams and columns	19
28	Thu	Structures – complex, hydrostatic <i>Problem Set 2 Due</i>	20,21
May 3	Tue	Cont. and review	
5	Thu	<b>Exam 1 (Solids)</b>	
<b>Part II: Fluid Mechanics</b>			
10	Tue	Resting fluids	4
12	Thu	Air-water interface	5
17	Tue	Flowing fluids <i>Problem Set 3</i>	6
19	Thu	Cont.	
24	Tue	Forces of flow <i>Problem Set 3 Due</i>	7
26	Thu	Moving in fluids – lift <i>Problem Set 4</i>	12
31	Tue	Moving in fluids – Thrust	13
June 2	Thu	Cont. and review <i>Problem Set 4 Due</i>	
<b>June 7</b>	<b>Tue</b>	<b>Exam 2 (Fluids- non-cumulative), 8:00-11:00 am</b>	