BioE 98/198: Breaking Down BioE Fall 2025

Time/Place: Mondays, 2:00-4:00 PM, SOCS180

~2 Classes per Module

> 1 Speaker Lecture, **1** Group discussion, **1** Journal Club, & **1** Skill Development

Course Credit: 2 units, Pass/Not Pass

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NOTE: Priority given to first-semester Freshmen, and Junior Transfers

COURSE OVERVIEW

Bioengineering is a highly interdisciplinary field that applies various engineering fields to biological systems. Historically, Bioengineering was first merged with Chemical Engineering to understand molecules' structure and function, including DNA, RNA, and proteins. Since then, various science and engineering disciplines have applied their principles to solve problems in biology utilizing principles of Electrical Engineering and Computer Science, Materials Science, Mechanical Engineering, and many more.

But as a newcomer to the field, how can you navigate your career path when there are so many options? How can you find those people you want to emulate? How can you identify what new, unexplored problems you want to tackle?

Breaking Down BioE will help answer these questions. We will explore the various concentrations of Bioengineering here at Berkeley and discover how other engineering disciplines apply to biological systems through speaker series, group discussions, journal clubs, and hands-on projects. These activities include working on collaborative projects, touring laboratories within academia and industry, and learning to build your professional profile with professional development workshops.

This course is designed to serve students who:

1. Intend to major in bioengineering and want to explore the four concentrations
2. Are undecided in their major choice and would like an introduction to the engineering disciplines through a biological lens
3. Have declared a major other than bioengineering and would like to explore applications of their major to solve problems in biology and medicine.

By exploring each application of Bioengineering, we help you discover the BioE concentration/engineering major that best simulates your interests. We enhance course and career planning by helping you select electives and develop your repertoire of professional and academic skills. By providing access to advice and guidance from our course instructor, Professor Dorian Liepmann, and BioEHS alumni/upperclassmen, we relate the classes in your intended discipline to your goals and passions.

LEARNING OBJECTIVES

1. **Understanding** the contemporary landscape of BioE through various engineering disciplines, ***informed by the experiences, advice, and insight of older BioE***

undergraduates and alumni

2. **Deconstructing *complex, real-world applications*** of Bioengineering into ***familiar, academic engineering concepts*** (also, in the process, applying a single set of fundamental BioE concepts to several distinct real-world applications)
3. **Networking**, accessing, and connecting with ***alumni, professors, and research scientists.***
4. **Developing intuition** about which ***personalized, BioE-based career pathway*** is best
5. **Increased familiarity** with ***on-campus resources relevant to aspired career pathway***
6. **Refining** professional and academic skills to best ***leverage past and future experiences***

TAKEAWAY: HOW DOES OUR COURSE HELP BIOENGINEERS? We aim to be the bridge between real-world BioE and on-campus resources. **As described in their course descriptions, BioE 25 & 26 provide an "opportunity to explore . . . specialties related to engineering in the pharmaceutical/biotech field." However, these classes do not explore which concentrations on campus teach the skills needed for those specialties. By selecting and navigating a single concentration without fully understanding how it relates to real-life BioE applications, students may not be adequately prepared for their career goals. In addition, these courses are often large, making them hard to connect to on an individual level. Ultimately, our class helps BioE students make thoroughly informed decisions about which concentration best caters to their career aspirations. In collaboration with our faculty sponsor Professor Dorian Liepmann, this course helps students select electives in line with their specific career goals and form a close-knit community of peers. In doing so, students connect with their courses on a deeper level.**

COURSE PREREQUISITES

No prerequisites are necessary to take this DeCal — simply an interest in and passion to learn about Bioengineering! Freshmen, sophomores, and junior transfer course applicants are given preference. Intended or declared Bioengineering majors and minors are given preference.

COURSE STRUCTURE

1. **1 two-hour class** per week.
2. **1 Module** per **2 classes** (1 Module = Speaker Lecture, Group Analytical Discussion, Journal Club Review, and Skill Development — ***elaborated below***)
    a. Module topics are predetermined, but students will be periodically polled for interest in other topics (e.g., Metabolic Engineering, Neurological Engineering, Prosthetic Engineering, etc.)
3. **5 Modules** over the course of the semester, culminating in a **final presentation day displaying the skills and knowledge acquired over the semester**

Elaborating on Class Elements

A. MODULE SYSTEM:

a. **Speaker Series:**
   i. For each module topic, there will be a speaker panel or lecture planned by the instructors. Speakers include BioEHS alumni, current researchers in the relevant field, and industry members.
   ii. The lectures are intended to provide deeper insight into novel advancements within the field, and what kinds of problems students can solve.
   iii. BioEHS has access to a large network of researchers, graduate students, senior scientists, and alumni. Therefore, we have the resources to host experienced, insightful guest speakers.
   iv. These presentations are meant to be short and will be followed by an interactive activity led by the speaker or a BioEHS member.

b. **Analytical Group Discussion:**
   i. The discussion will serve as a reflection on the Speaker Series — what **core BioE concepts** are "buried" in the speaker's field of study, career pathway, or device? In other words, how do we break down the speaker's real-world application of BioE into its constituent, familiar, core engineering concepts?

c. Journal Club Review:
   i. Journal Club articles are based on the core BioE concepts extracted from the prior week's guest speaker and analytical group discussion. Students will participate in article discussions to prepare for the final journal club student-led presentations. Groups will be assigned a mentor from BioEHS to help them guide their presentation and journal article selection.
   ii. Each group's selected publication should explore a novel BioE application that hinges on the core BioE concepts. Students are recommended to start with a product or start-up and backtrack to an academic paper that highlights the science behind the innovation. Both an overview of the application and the academic paper should be reviewed in the journal club presentation. However, the publication should not cover a BioE application explicitly covered by the speaker.

d. **Professional Skill Development:**
   i. There are a certain set of non-technical core skills all BioEs need to succeed, regardless of career path. To cater to the specific needs of our students, a specialized training day will be implemented based on a poll conducted by the facilitators.
   ii. These trainings will be especially useful to incoming students, who may not have been introduced to them before; however, they also involve a practical component to develop each skill—which will be useful to all students.

B. PRESENTATION DAY:

a. **Final presentation**:
   i. Students will prepare a final presentation summarizing a paper highlighting their technical, research, and presentation abilities

C. COURSE ADVISING COMPONENT:

a. BioEHS advising panels to help students discover which concentration, majors/minors, and electives would be best for their interests. Most importantly, this component of the

class heightens student engagement with the courses in their concentrations.

b. The final week of the course will be dedicated to course advising, primarily conducted by members of BioEHS. This component concretely bridges external BioE career pathways to on-campus academic resources & concentration framework. It will focus on helping students select which concentration and electives best suit their career aspirations.

c. The guest facilitators (members of BioEHS, and our faculty sponsor) will cover how the subfields of BioE intersect with the four offered concentrations, and host Q&A sessions for the students. This is to ensure students attain insight into courses based on the lived experiences of those who have been in similar academic concentrations.

d. To prevent student disengagement, the course advising will center on the modules most central to the course applicants' interests (based on a survey that will be sent out later in the course).

GRADING POLICIES

A passing grade (P) is awarded to students who complete all of the course material. The material is as follows:

1. Homework
    a. WRITING:
        i. Homework should be submitted at the beginning of every class
        ii. Students are allowed to drop **two** homeworks
        iii. **Responses in the form of essays, or literary research, to a question presented by the instructors at the end of each class.**
        iv. Intended to reinforce the main ideas presented in each class, while also allowing for personal reflection, perspective, and introspection.
        v. Should not take more than **thirty minutes to an hour** to complete.
    b. READING:
        i. Each student is expected to **answer questions based on the journal article** being presented for the upcoming module's Journal Club review. Reading articles will be started in class as a group, and students will complete the questions as homework. This allows all students to have exposure to scientific literature related to the module. This should not take more than **one hour** to complete. These will be **due at the beginning of the next module**.
        ii. Please refer to the Reading List section at the end of the syllabus for the first two weeks' assignments.
    c. DISCUSSION WORKSHEETS:
        i. We will be providing discussion worksheets about the content in each module. These are intended to be group activities to learn the material and meet new people. If the worksheet is not completed during class time, you will be able to **submit it by the beginning of the next class period**. These will be graded on **effort/completion**.
2. Final Presentation Day
    a. Students will be put into groups of four to five. Each group, under the mentorship of a BioEHS member/DeCal Facilitator, will break down a paper in an area of interest in detail in a 15-minute presentation. Students should be able to thoroughly explain the content of the study to an audience not versed in the field

and answer questions about potential applications not listed in the paper.

3. Attendance & Participation
    a. Students are allowed to miss **two classes** in total (with exceptions for special circumstances, e.g., midterms or athletic events). Students who miss more will not pass the class.
    b. Students must inform instructors by the **second week of class** through email of any planned absences (sports, midterms). Students must email instructors ASAP regarding any extraordinary circumstances.
    c. **Two unexcused late attendances count for one absence**. Arriving 20 minutes after class begins (class begins at 6:10 PM) will count as tardiness.
    d. In-class participation will be graded based on engagement within the class. This includes asking insightful questions, collaborating with your peers during team discussions/projects, and contributing to the class learning environment.

Grading for homework assignments, journal club projects, and the final presentation day are mainly based on the effort students put in. Students will receive either P or NP for each assignment. Those who receive NP for a homework assignment can choose to redo the assignment. However, the journal club and final projects cannot be redone.

Grading Percentage Breakdown

Homework 35%
Final Presentation Day 20%
Attendance & Participation 45%

OTHER CLASS POLICIES

Plagiarism is considered academic dishonesty. Any plagiarism on assignments in this class will result in a NP grade, as well as possible disciplinary action from the University Office of Student Conduct.

WEEKLY SCHEDULE

*Guest speakers are subject to change due to scheduling availability.

Section	Class	Lecture	Homework
01. Introduction	1 (MON, Sep. 8)	01. WELCOME, Class Overview, Community Building 02. Keynote speaker: *How To Succeed in BioE & Berkeley* Professor Dorian Liepmann	01. Personal Goals Reflection 02. Interest Survey 03. 5 Goals for the Semester
	2 (MON, Sep. 15)	01. **Skill:** Reading Scientific Literature 02. How to Succeed @ Berkeley: What we wish we knew during our 1st semester!	01. Interest Survey 02. Prepare Speaker Questions 03. Workshop Feedback Form
02. Module 1: **Biomedical Imaging**	3 (MON, Sep. 22)	01. Biomedical Imaging & Life @ Berkeley Professor Guest Lecture 02. ImageJ workshop	01. Speaker Series Personal Reflections 02. JC guiding questions
	4 (MON, Sep. 29)	01. **Skill:** How to get undergrad research/cold emailing 02. Module 1 Journal Club OR 01. Lab Tour: TBA	01. Skills Reflection 02. Finish Discussion Worksheet
03. Module 2: **Synthetic & Computational Biology**	5 (MON, Oct. 6)	01. What is Synthetic Biology Guest Lecture 02. Module 2 Journal Club	01. Speaker Series Personal Reflections 02. Finish JC guiding questions
	6 (MON, Oct. 13)	01. Discussion Worksheet: Comp bio/ syn bio 02. Bioengineers in Consulting **03. Skill:** Alphafold Workshop	01. Finish Discussion Worksheet 02. Think about classes for next semester and shortlist your favorites

04. Module 3: **Cell & Tissue Engineering**	7 (MON, Oct. 20)	01. Cell & Tissue Engineering Guest Lecture 02. Course advising (get advice from upperclassmen)	01. Speaker Series Personal Reflection 02. Update 4-year plan
	8 (MON, Oct. 27)	01. Module 3 Journal Club 02. **Skill**: Resume/CV Feedback & Cover Letter (ask BioEHS upperclassmen to come)	01. Write a draft of a cold email to the most interesting lab of your choice
	9 (MON, Nov. 3)	01. Pipetting/Wet lab workshop 02. **Skill:** Presentation Making & Public Speaking	01. Write a reflection on the favorite thing you learned 02. Update resume based on feedback
05. Module 4: **Devices**	10 (MON, Nov. 10)	01. Module 4 Biomedical Devices Guest Speaker 02. **Skill:** Devices Workshop (3D printing/Arduino) 03. Module 4 Journal Club	01. Speaker Series Reflection 02. Workshop Feedback form
	11 (MON, Nov. 17)	01. Bakar BioEnginuity Hub Tour/BNC Tour/Jacobs Tour 02. Begin final paper presentation	01. Tour reflection 02. Bring resume to next class (Nov. 29th) 03. Work on the final project
	12 (MON, Nov. 24)	NO CLASS (Thanksgiving break)	
06. Module 5: Industry, BioE, & Career Advising	13 (MON, Dec. 1)	01. Presentations 02. Pizza party + senior look back panel	01. Have a great break and good luck on finals!

ADDITIONAL INFORMATION

Course Overview:

Our class aims to empower BioE students to carve out a course plan that best caters to their particular subfield of interest, rather than one limited by their concentration.

Central Questions:

How do the courses on campus intersect with the vast, and often inaccessible, real-world applications/subsets of the BioE industry? How do I take steps towards my BioE subfield of interest, and develop the skills needed to thrive in it?

Why do we need a course like this?

From the perspective of a current BioE undergraduate:

"I think the main thing by far I would have liked to have as a freshman would be a better way to understand **what you can do with a BioE degree** (for example, the types of industry jobs or specific types of research), and **why those areas specifically related to BioE** (as opposed to MCB/EECS/MSE/etc.). I really didn't even have the context to properly understand the question of what I wanted to do with BioE or why I was BioE until my third year, especially since the first 2 years are primarily all lower division courses and are pretty removed from the major. That's by far the thing I've also heard other first/second years lost about."

Has this need been met already?

Many opportunities on campus provide a good community and help undergraduates learn what BioE is about. However, there is no resource available to help students explicitly identify what new, unexplored problems they want to tackle, and, more importantly, what courses help them solve such problems. See below for our in-depth explanation.

01. What about BioE 25/26?

a. BioE 25 & 26 offer an "opportunity to explore...specialties related to engineering in the pharmaceutical/biotech field." However, BioE 25 & 26 do **not** explore **which courses on campus teach the skills** needed for those specialties.

02. How is this course unique from the four concentrations themselves?

a. While four academic concentrations provide a structured framework with which to interpret the landscape of BioE, many careers in the real world are in fact **combinations of these concentrations** (from orthopedic bioengineering to medical imaging theory and analysis, several bioengineering subfields require knowledge derived from more than one concentration).

b. Therefore, linearly navigating a single concentration in isolation without dabbling in the others may be inadequate to prepare students for their goals.

c. **Again, our class aims to enable students to carve out a course plan that best caters to their particular subfield of interest, rather than one limited by their concentration.** We do this by providing a wider, intersectional level of understanding of real-world applications of BioE.

03. Doesn't the BioE Department have this kind of resource?

a. *Teachers?*

i. Experiences on courses from the student perspective have their own value—there is a shared experience of having gone through the same academic program. There is unique insight in understanding how teachers operate, a perspective faculty might not be able to duplicate or provide.

ii. Approaching faculty can be intimidating, especially for incoming students

b. Peer Advisors:

i. There are one to two BioE-specific peer advisors with limited availability—in comparison, the DeCal will offer two hours each week personalized to the student's needs and interests, utilizing a variety of BioE perspectives, concentrations, and pathways (a minimum of six panelists to guide course students).

04. What about the Bioengineering Honor Society (BioEHS)?

a. BioEHS's resources are limited primarily to its members.

i. The DeCal would be available to the UC Berkeley community at large

ii. This is especially helpful for first-semester freshmen, who are often most in need of dedicated attention in these areas

b. *The opportunities that are unique and exclusive to BioEHS members, are still maintained!*

i. The DeCal does **not** overlap with most of BioEHS's member-specific events, including (but not limited to): graduate school/medical school panels, upperclassmen speed networking, study sessions, professor luncheons, or school visits

ii. Let's address the ***potential*** areas of overlap — the DeCal schedule advising & journal clubs

1. DeCal Journal Club vs. Blog Writing in Outreach — they differ in intention and execution:

a. DeCal: here, students break down a scientific paper to identify its core "BioE building blocks" or concepts and subfields; then, they re-apply those core ideas to a separate subfield to recognize the versatility and intersectionality of those concepts

b. Blog Writing in Outreach: students break down a BioE topic into language and concepts that high school students can understand, to explain what that topic is (not so much its intersectionality with other fields)

2. Schedule advising:

a. DeCal schedule advising has a heavier focus on career goals of students than BioEHS schedule advising b. While this is an area of overlap, schedule advising is a resource that can be re-optimized, and re-used semester by semester — after taking the DeCal, if anyone intends to apply to BioEHS the following semester, they can still take

advantage of updated course advising

05. What about the BioESP Program?

a. BioESP lecturers are not often current students who have gone through the ropes of current Berkeley bioengineering.

b. DeCal speakers are recent alumni, and researchers (grad/post-docs) on campus who created their own path to get into research, and who have had more freedom to develop their own research. The guest speaker lectures only become problematic if we start to rely on industry folk/PIs since that is what is primarily offered in BioE 25, 26, and BioESP. We have designed our course to focus on alumni speakers.

c. The BioESP Program caters to a specific audience (historically underrepresented backgrounds). The main focus of BioESP is to enrich the diversity of BioE, and provide them with research experience and advising — however, those who have done BioESP still have maintained that schedule advising hasn't always been the best across the BioE Department—this is a need the DeCal can satisfy.

06. E98?

a. The E98 Syllabus (https://e98.berkeley.edu/) focuses far more on skills pertaining to general life at Cal. Our course instead is focused on developing academic and professional skills and knowledge **within the context of *specific* BioE sub-disciplines**, geared by speaker sessions, journal clubs, and discussions.

b. In the areas where the two courses intersect on paper, the BioE perspective from students who have gone through BioE training makes this DeCal specifically and vitally distinct from E98. Similarly, this DeCal may intersect with E98 course advising, but it has the BioE perspective and depth of experience.

REQUIRED READINGS

Module 1: Biomedical Imaging

- *Magnetic Particle Imaging: A Novel in Vivo Imaging Platform for Cancer Detection*
  - https://doi.org/10.1021/acs.nanolett.6b04865
- *Association between enhanced carbonyl stress and decreased apparent axonal density in schizophrenia by multimodal white matter imaging*
  - https://doi.org/10.1038/s41598-023-39379-w

Module 2: Synthetic and Computational Biology

- *Repurposing CRISPR as an RNA-Guided Platform for Sequence-Specific Control of Gene Expression*
  - https://doi.org/10.1016/j.cell.2013.02.022
- *Highly accurate protein structure prediction with AlphaFold*
  - https://doi.org/10.1038/s41586-021-03819-2

Module 3: Cell and Tissue Engineering

- *Advances Tissue Engineering and Regenerative Medicine*
  - https://doi.org/10.1155/2018/2495848
- *Autologous treatment for ALS with implication for broad neuroprotection*
  - https://doi.org/10.1186/s40035-022-00290-5

Module 4: Biomedical Devices

- *Walking naturally after spinal cord injury using a brain–spine interface*
  - https://doi.org/10.1038/s41586-023-06094-5
- *Neuropixels 2.0: A miniaturized high-density probe for stable, long-term brain Recordings*
  - https://doi.org/10.1126/science.abf4588