

University of Colorado Boulder

BIEN 3800: Fundamentals of Biotechnology (Fall 2025)

Syllabus

Course and Contact Information

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<u>Teaching Fellow:</u>	Emma Aldrich Email – emma.aldrich@colorado.edu
<u>Class Days/Time:</u>	Tuesdays and Thursdays; 2:30 – 3:45 PM
<u>Classroom:</u>	BIOT A115
<u>TAs:</u>	Michelle Croen, michelle.croen@colorado.edu Kira Palau, kira.palau@colorado.edu
<u>Help Hours:</u>	See Canvas for individual instructor and TA help hours.
<u>Prerequisites:</u>	Requires prerequisite courses of BIEN 2810 or MCDB 1150 or EBIO 1220 and APPM 1350 or MATH 1300 and CHEN 1201 or CHEN 1211 or CHEM 1113 or MCEN 1024 (all minimum grade C-).

Course Description

Surveys the five areas of modern biotechnology (human, animal, industrial, agricultural, environmental), highlighting engineering principles in biology in all five areas. Delves into how biology is used to create useful materials and medicines. Imparts a working knowledge of synthetic DNA technology, including recombinant DNA, genome editing, DNA synthesis, and DNA sequencing. This course is intended as a core undergraduate Biological Engineering course focusing on the fundamentals of biotechnology. This course will begin with an overview of the foundations of biotechnology, and then dive into engineering principle in five sectors of application: human health, animals, bioprocessesing/industrial, agricultural, and environmental.

Course Learning Objectives

Upon successful completion of this course, students will be able to:

- **Identify** emergent properties across biological scales, ranging from DNA to cells, tissues, organism, and ecosystems
- **Integrate** science and mathematical concepts with creativity and ethical considerations to generate solutions to biotechnological problems
- **Apply** biological concepts to cutting edge technological developments in human health, agriculture, industry, and environment
- **Analyze** ethical issues surrounding biotechnology and biological engineering practice
- **Synthesize** recent advances, challenges, and opportunities in biotechnology peer-reviewed literature
- **Communicate** effectively with a range of audiences

Course Format

Creative applications of biology to create new technologies are at the core of this course. Thus, discussions, collective brainstorming and activities that exercise our creativity will be common during class meetings. Materials from the textbook and other resources provided by the instructors will be reinforced in class meetings along with class preparation questions, homework assignments, case studies, a group project, and content integration exercises. In class, students may benefit from having an internet-connected device (e.g. smartphone, tablet, laptop computer) to be used exclusively for learning-related activities, including the iClicker technology available at CU Boulder.

Resources to support the class content beyond the course textbook will be posted on Canvas with the corresponding class meeting identified. During class, we will ask several iClicker questions that help us stay connected to how well the class is understanding important concepts. Homework will cover the material from the previous class meetings. Periodic case studies (see course schedule) will support creative idea generation related to course concepts via group discussion. Readings will be assigned as a primer to class meetings with class preparation questions due at the beginning of the week to help solidify important concepts. Content integration exercises will extend case study discussions to integrate case study concepts with previous course materials. We will hold help hours during the week, as will the teaching assistants (TAs), meaning there is plenty of help available to you, but it is up to you to use it!

Class Participation Expectations

You will get the most out of this class if you are present and engaged. This course will mix learning about the fundamentals of biotechnology with ethical considerations and creative thinking opportunities. Active learning and class discussions are a part of the course design, and we will use iClicker questions to stay connected during class. Research repeatedly shows that

being prepared for and engaged in class significantly improves your learning; therefore, you will find it helpful to complete any preparatory readings ahead of time. Your contributions to class are valuable and there will be many opportunities to communicate with your peers to build out the classroom culture and learn from each other. Content from class meetings may not be posted in full on Canvas, so your complete understanding of the material will require your presence in class. If you miss a class, you may consult with a classmate or a TA to catch up on the classroom content.

Course Website (Canvas)

Course materials such as the syllabus, handouts, notes, assignment instructions, etc. can be found on the course website on Canvas. All communication relevant to the course will be sent out using the Canvas messaging system (Canvas email and announcement board). You are responsible for keeping up with deadlines and regularly checking the messaging system through Canvas to learn of any updates. You will find it most helpful to set email notifications to “immediate” to receive timely Canvas updates in your email inbox.

Help Hours

Please refer to the Canvas course page to see the individual instructor and TA help hours. We encourage you to come by for help hours to discuss homework, questions about class, or larger discussions about your engineering pathway at CU, life as an engineer, or anything else on your mind. This time is set aside for you, and we love to have you come by!

Required Texts/Readings

Required textbook:

- Clark, D.P., & Pazdernik, N.J. *Biotechnology*. Academic Cell, 2nd Edition (2016).

Available online: <https://www.sciencedirect.com/book/9780123850157/biotechnology>

****Additional readings and/or resources will be made available by posting on Canvas.*

Course Requirements and Assignments

Success in this course is based on the expectation that students will spend a minimum of 6 hours over the course of each week on preparation/studying, assignments, and other course related activities. Students are expected to attend all class meetings not only because you are responsible for material discussed therein, but also because active participation is essential to ensure maximum learning benefits for all members of the class. Attainment of the learning objectives (as listed above) will be assessed via class preparation question, clicker questions, homework assignments, case studies, a group project, and content integration exercises.

Emailing In This Course

Use the Discussions tab of Canvas for all questions except for anything of a personal nature. This practice will ensure everyone has the same answer for all questions. If you need to email an instructor, include both “BIEN 3800” and a short description of your questions or issue in the subject line. We will respond within 24 hours during the week or as soon as possible after a weekend. During the week, emails received between 8am-5pm are likely to be answered more rapidly; emails received after 5pm will likely receive a response the next day. Emails received during the weekend will likely receive a response on the following Monday. If for some reason you haven’t received a response, please reach out again to make sure your email was not missed.

Where To Get Help

There are several resources available to support your success during the semester. You will have classmates to work with during the semester, and the teaching team can also provide support. Help hours are a great way to ask questions and get direct support. Learn more about how to get the best out of those periods: <https://www.colorado.edu/studentaffairs/make-most-office-hours-semester>. Students Support & Advising Services also has great resources: <https://www.colorado.edu/engineering-advising/academic-support-tutoring>. Your academic advisors can also be a great person to contact if you need support or have questions.

If you are struggling with the course, feel free to contact Prof. Franklin, or any member of the teaching team. If you are feeling overwhelmed or worried about a friend, please reach out to one of your instructors or your academic advisor. We can try to help, or we can put you in touch with someone who can help. CU Boulder has both peers who are trained to listen and help (<https://www.colorado.edu/health/pwc>), as well as mental health counselors (<https://www.colorado.edu/counseling/>).

In The Classroom

The main goal of this course is to help you build a foundation upon which to continue exploring biotechnology at CU and to expand the ways in which you approach complex problems using biological tools. We learn from mistakes and failure. Those are an essential part of learning and are not a determination of your abilities. To support the messy side of learning and focus on the process (rather than the product of the “right answer” or the highest grade), a classroom that prioritizes respect is essential. We expect you to help create that community. We will need patience or courage or imagination or any number of qualities in combination to engage in our materials, with our classmates, and leverage our ideas and experiences for learning and growing.

It is our intent that any student that meets the prerequisites can be successful in this course, that students’ learning needs be addressed both in and out of class, and that the ideas that students bring to this class be framed as a resource, strength, and benefit. Your suggestions are encouraged and appreciated. Please do not wait until the end of the semester to give this

feedback. Please let us know ways to improve the effectiveness of the course for you personally or for other students. You can email the instructor at any time, come to help hours, or provide anonymous feedback during opportunities in this course.

Assignments & Methods of Assessing Student Achievement

Homework

Regularly spaced homework assignments will be posted to Canvas one week before the due date. Homework will typically be due Thursdays by 2:30 PM (the start of class). Homework should be uploaded in .pdf format to Gradescope. Your work must be neat, legible, and well-organized. If we cannot understand your work, we will not attempt to grade it. Following the release of feedback/grades, a new resubmission deadline will be set by which you will be able to resubmit your homework to improve your grade up and recover up to full points. Any solutions/answers are not attempted in full by the original deadline will be limited to 50% of full credit upon resubmission.

Students are expected and encouraged to work together on assignments. However, you must solve the problems yourself and copying from solution manuals, generative AI, or each other is strictly forbidden. It must be clear that each individual's homework submission is original work. To be ready for content integration exercises, you'll need to be able to do all the problems on your own. It is a violation of the CU Honor Code to utilize a site such as Chegg.com or coursehero.com to upload, download, or receive help on assignments that do not permit consultation. Using these sites and other forms of cheating is unfair to your classmates. The consequence for cheating or plagiarism is a zero on the assignment and reporting to the CU Honor Code; multiple instances or severe cases of cheating/plagiarism will result in an automatic F grade for the semester.

All homework answers should include a confidence score of 1 (low level of confidence), 2 (moderate/wavering confidence), or 3 (high level of confidence). Confidence scores help us adjust our instruction and feedback; they will not affect the assessment level, meaning they have no influence on the grade determination.

Class Preparation Questions

Reading material will be posted on Canvas at least one week before the class meetings at which the content will be discussed. Our time in class is limited and to connect most deeply with the course content requires priming our memories ahead of time with the nuances of each class topic. Class preparation questions will be due Tuesdays by 2:30 PM (start of class) covering the reading for the Tuesday and Thursday class meetings of that week. Questions are posted on and completed on Canvas by the deadline and will reinforce the most important skills, techniques, and topics from the reading. The lowest of these grades will be dropped from your final grade at the end of the semester. Class preparation questions must be completed individually. The

consequence for cheating or plagiarism (from peers, generative AI, or online resources) is a zero on the assignment and reporting to the CU Honor Code; multiple instances or severe cases of cheating/plagiarism will result in an automatic F grade for the semester.

Case Studies

At three points during the semester (see course schedule), our normal class meeting format will change to focus on group discussion and ideation focusing on opportunities to use biotechnology in a particular application (the “case study”). Each case study will be an opportunity to apply concepts from the course up to that point for an envisioned application; the first will focus on human health, the second on bioprocessing, and the third on environmental biotechnology. Prior to the first case study, groups will be formed that will work together for the three case studies and the group project. Groups will complete preparatory reading and questions posted on Canvas before the case study to begin brainstorming that will guide the case study class meeting. In the case study class meeting, groups will continue to brainstorm and propose biotechnology solutions to the class as we explore how biotechnology can be applied in the chosen case. Group brainstorming in the class will take place via shared online tools (e.g., Google Sheets) and through class-wide discussion.

Group Project

At the end of the semester, a group project will be due during the finals week period that builds on the progress made in each case study. Groups that have been working together throughout the semester will create a presentation to pitch biotechnology solutions to “investors” for an engineering endeavor introduced during earlier case studies. Groups will be able to take their own brainstorming from each case study, as well as the ideas from peers learned during the case study class meetings, so make selections of biotechnological tools for an engineering endeavor and explain/justify those decisions to stakeholders who are deciding whether or not to support the endeavor. The deliverable will take the form of a recorded (on Zoom) presentation pitching selected biotechnologies. Details of the project will be presented before the first case study.

Content Integration Exercises

Following each case study, you will expand your thoughts through “content integration exercises,” to be completed on your own and at your own pace. There will be a set of questions that touch upon topics from the case study and that make connections to topics covered in class thus far. These questions will be similar to the style of questions on homework assignments. Content integration exercises will be posted on the date of the case study class meeting and due a few days later (see Course Schedule posted on Canvas). Students will be able to start the exercise at any time before the deadline, but will only be given a limited period of time (see

individual assignments) to complete the exercise once started. You may use any resources from the course but must work on these individually and without group support. The consequence for cheating or plagiarism (from peers, generative AI, or online resources) is a zero on the assignment and reporting to the CU Honor Code; multiple instances or severe cases of cheating/plagiarism will result in an automatic F grade for the semester.

iClickers

In each class, we will ask between 1-10 clicker questions to remain connected to the level of understanding in the classroom. Each class will begin with 2-3 questions focused on content from the *previous* class meeting's materials and additional questions will focus on comprehension of the material being discussed that day. Each day's set of questions will be worth a total of 5 points, 4 for responding and 1 for accuracy/correctness. Submitting clicker questions if you are not in class is considered clicker fraud and is a violation of the CU Honor Code. If a student is found responsible for clicker fraud in the form of responding to clicker questions when not in class or responding for another student, those students will receive no credit for clickers for the semester. At the end of the semester, 20 clicker points will be returned to facilitate missed classes, meaning approximately 2 weeks of class meetings can be missed with no clicker consequences.

Grading Information

Grades will be determined based on all the assignments and examinations, weighted as reported in the table below:

40%	Homework
10%	Class Preparation Questions
15%	Case Studies
15%	Content Integration Exercises
10%	Group Project
10%	iClickers

Grades will be assigned according to CU Boulder's grading scale:

Letter	Percentage
A	94% to 100%
A-	90% to < 94%
B+	87% to < 90%
B	83% to < 87%
B-	80% to < 83%

C+	77% to < 80%
C	73% to < 77%
C-	70% to < 73%
D+	67% to < 70%
D	63% to < 67%
D-	60% to < 63%
F	0% to < 60%

University Policies

The campus policies can also be found [here](#).

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the [Honor Code](#). Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. Understanding the course's syllabus is a vital part of adhering to the Honor Code.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: StudentConduct@colorado.edu. Students found responsible for violating the Honor Code will be assigned resolution outcomes from Student Conduct & Conflict Resolution and will be subject to academic sanctions from the faculty member. Visit [Honor Code](#) for more information on the academic integrity policy.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the [Disability Services website](#). Contact Disability Services at 303-492-8671 or DSinfo@colorado.edu for further assistance. If you have a temporary medical condition, see [Temporary Medical Conditions](#) on the Disability Services website.

If you have a temporary illness, injury or required medical isolation for which you require adjustment, please contact the course instructor in addition to seeking the support from Temporary Medical Conditions (link above).

Accommodation for Religious Obligations

Campus policy requires faculty to provide reasonable accommodations for students who, because of religious obligations, have conflicts with scheduled exams, assignments, or required attendance. Please communicate the need for a religious accommodation in a timely manner. In this class, please talk with the instructors if conflicts arise. See the [campus policy regarding religious observances](#) for full details.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information does not always align with how they identify. If you wish to have your preferred name (rather than your legal name) and/or your preferred pronouns appear on your instructors' class rosters and in Canvas, visit the [Registrar's website](#) for instructions on how to change your personal information in university systems.

Classroom Behavior

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, marital status, political affiliation, or political philosophy.

Additional classroom behavior information

- [Student Classroom and Course-Related Behavior Policy.](#)
- [Student Code of Conduct.](#)
- [Office of Institutional Equity and Compliance.](#)
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Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits [protected-class](#) discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who have been subjected to misconduct can contact OIEC at 303-492-2127 or email OIEC@colorado.edu. Information about university policies, [reporting options](#), and [OIEC support resources](#) including confidential services can be found on the [OIEC website](#).

Please know that faculty and graduate instructors are required to inform OIEC when they are made aware of incidents related to these concerns regardless of when or where something occurred. This is to ensure the person impacted receives outreach from OIEC about resolution options and support resources. To learn more about reporting and support a variety of concerns, visit the [Don't Ignore It page](#).

Mental Health and Wellness

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact [Counseling and Psychiatric Services \(CAPS\)](#), located in C4C, or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through [AcademicLiveCare](#). The [AcademicLiveCare](#) site also provides information about additional wellness services on campus that are available to students.

Acceptable Use of AI in This Class

Generative artificial intelligence tools—software that reproduces text, images, computer code, audio, video, and other content—have become widely available. Well-known examples include ChatGPT for text and DALL•E for images. This statement governs all such tools, including those released during our semester together.

Keep in mind that the goal of gen AI tools is to reproduce content that seems to have been produced by a human, not to produce accurate or reliable content; therefore, relying on a gen AI tool may result in your submission of inaccurate content. It is your responsibility—not the tool's—to assure the quality, integrity, and accuracy of work you submit in any college course.

If gen AI tool use is suspected in completing assignments for this course in ways not explicitly authorized, I will follow up with you. I may contact the Office of Student Conduct & Conflict Resolution to report suspected Honor Code violations. In addition, you must be wary of unintentional plagiarism or data fabrication. Please act with integrity, for the sake of both your personal character and your academic record.

While you may use generative artificial intelligence (Gen AI) tools to help you learn in this course (limited to grammar checks, generating ideas or outlines, or understanding content), you may not submit any work for any assignment that was produced by Gen AI tools (unless prompted to do so). All final work submitted in this class must be your own, student-generated, original work. If you use gen AI tools on assignments in this course, document your usage with the [Chicago Manual of Style](#).