

BIEN 4820
Bioseparations

MWF 12:50-1:40
BIOT B231

Instructor:
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Office hours: Tues. 4:00-6:00 BIOT B231

TAs:
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Required Text: Bioseparations Science and Engineering (2nd Edition)
Harrison, Todd, Rudge, and Petrides
Oxford University Press

What this course is about: In this course, we will explore a variety of means that are used to purify molecules made using biotechnology. Some of the topics that will be addressed include cell lysis, flocculation, filtration and ultrafiltration, precipitation, crystallization, chromatographic separations, and drying. Many of the applications involve separations needed to produce the highly pure biomolecules used in therapeutics and vaccines.

Background knowledge: Bioseparations are conducted by taking advantage of special properties of biomolecules in order to purify them. We will mention how these special attributes get used, but we will assume that you have some basic background in biochemistry and biology. We will also assume a basic familiarity with separations, kinetics, thermodynamics and mass transfer.

Why might you be interested? Separations are a critical part of industrial bioprocesses. Especially in biopharmaceutical arena, engineers who can design efficient separation processes are in high demand. Separations techniques used in biotechnology, while based on the same principles as those used in other industrial separations processes, tend to be specialized to handle the demands of ultra-high purity separations of delicate molecules.

Schedule (Subject to Modification):

Week	HW Due	Subject	Reading	Notes
Week 1 Aug 22		Bioseparations- Intro:what's different?		
Week 2 August 25, 27, 29	HW1 Due Aug 29	Basic definitions, methods survey	Reading: Chapters (1)&2 Reading Quiz 1 due Aug 25	
Week 3 Sep 3,5	HW2 Due Sep 5	Cell lysis, flocculation	Reading Chapter 3 Quiz 2 due Sep 3	Labor Day Sep 1 Note- due to Labor Day, Reading quiz is due on Wed this week
Week 4 Sep 8,10,12	HW3 Due Sep 12	Filtration	Reading Chapter 4 Reading Quiz 3 due Sep 8	
Week 5 Sep 15, 17,19		Filtration		
Week 6 Sep 22,24, 26	HW4 Due Sep 26	Sedimentation Analytical Ultracentrifugation, Continuous centrifugation	Reading Chapter 5 Reading Quiz 4 due Sept 22	
Week 7 Sept 29, Oct 1, 3		Extraction, Equilibrium Fixed bed mass balance In-class brief Exam review Sep 29	Ch 6 Reading quiz Sep 29	Thursday Oct 2 Exam I 7:30-9:00 Exam location: Online
Week 8 Oct 6, 8,10	HW5 Due Oct 10	Adsorption Chromatography	Ch7.1-7.3.2 Ch 7.4 Reading quiz 6 due Oct 6	
Week 9 Oct `13,15, 17	HW6 Due Oct 17	Chromatography / Plate Models for chromatography	Ch 7.7-7.10 Reading Quiz 7 due Oct 13	

Week 10 Oct 20, 22,24	HW7 Due Oct 24	Chromatography / chromatography resins/ Chromatography Scale-up/ Precipitation / Population Balance	Ch8 Reading Quiz 8 due Oct 20	
Week 11 Oct 27, 29, 31	HW8 Due Oct 31	Moment analysis, Crystallization – Nucleation,	Ch 9 Reading Quiz 9 due Oct 27	
Week 12 Nov 3, 5, 7	HW9 Due Nov 7	Batch Crystallization Evaporation	Ch 10 Reading Quiz 10 due Nov 3	
Week 13 Nov 10,12,14		Drying / Spray Drying Equilibrium Moisture curves	Ch 11 Reading Quiz 11 due Nov 10	Nov 14 Exam II in class
Week 14 Nov 17, 19, 21	HW10 Due Nov 21	Drying / Lyophilization / Freezing, ice nucleation, Ostwald ripening Glass transitions		
Nov 24-28	Thanksgiving Week Break			
Week 15 Dec 1, 3 5	HW 11 Due Dec 5	Partially solved Bioseparations challenges- Virus Purification, chiral sep'n Final Review		
Dec 8				FINAL 4:30-7:00

Grades: The grades for BIEN 4820 will be assigned based on the following weighting:

Homework: 20%

Reading Quizzes: 10%

Midterms: 2x 20%

Final 30%

Homework: Assignments will be due at the start of class. Homework can be done in groups of no more than three people. Only one assignment needs to be turned in per group; all group members should sign homework acknowledging that they contributed to the assignment. No late homework will be accepted.

Reading Quizzes: Reading quizzes will be available on Canvas starting a week before the due date. Quizzes will close at noon. on the quiz due date.

The fine print:

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, contact the professor to work out any needed arrangement.

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 let me know as soon as possible by email if you have any such conflicts. 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.