MCB C117/PMB C136 Advanced Plant Biochemistry (4 Units)

Instructor - lectures: 3h per week, 1 section, MWF
GSI - tutorial: 1h per week, 1 section, Tu
GSI - discussion: 1h per week, 2 sections, Th

Office hours - Instructor: TBD
Office hours – GSI: TBD

Pre-requisites: MCB102 or PMB135

Text: Biochemistry and Molecular Biology of Plants by Buchanan, Gruissem and Jones., 2nd edition, also available as e-text from UC library.
Other literature: Posted on bCourses, and within the links in the syllabus.

Reading assignments: Assigned with topic, plus papers as listed in bCourses. The reading assignments are an integral part of this course.

Learning objectives: A key goal of this class will be to teach you how to assimilate material from your own reading of textbooks, reviews and journal articles. You will learn by asking and answering questions with the goal of learning (rather than exam preparation). Therefore, all exams will be open book/notes and will test you on your ability to understand what you are reading and your ability to synthesize new material.

Another objective in this class is to encourage collaboration. We will use a team approach for discussing the papers in weeks 10-14. You may also discuss and collaborate on homework assignments. All collaborators will turn in a single report / paper and get the same score.

A third objective is to expose you to data collection and data analysis via tutorials.

Discussion topics: Discussion will focus on experimental approaches

Tutorials: Tutorials will be distributed with field work (2h in the botanical garden to collect fluorescence spectra on plants in various environments), data analysis (using R packages for transcriptomics), as well as hands-on training in soft skills. A laptop* will be required.
*Device Lending from Student Technology Services: studenttech.berkeley.edu/devicelending
Library Electronic Devices Lending: lib.berkeley.edu/using-the-libraries/laptop-lending

Grading: 2 take home assignments (2 x 20), 2 in class open-notes (no devices) exams, see sample on bCourses (2 x 25), 4 quizzes (4 x 10), 1 team presentation (1 x 30), final exam (1 x 40) = 200 points, see ** for dates of assignments and exams

Lecture schedule

Week 1

Date Topic and Reading

Jan 18 the plant cell – review plus specialized features, plastid, oil bodies, cell wall, vacuoles, peroxisomes
(Chapter 1)
Jan 20 plastids – various types, plastoglobules, plastid division, inheritance, endosymbiosis
(Chapter 1)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-042817-040209
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-050312-120144
http://www.plantcell.org/content/21/10/tpc.109.tt1009

Tutorial topic: Literature searches (Pubmed, Web of Knowledge),
Reference managers (Endnote and Mendeley)
Discussion topic: cell / organelle fractionation (Box 4.1 and 4.2)

Week 2

Jan 23 plastid genome, expression and engineering
(Chapter 6)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-050213-040212
Jan 25 membrane proteins and transport
(Chapter 3)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-042110-103903
Jan 27 Plastid protein import
(Chapter 4)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-042809-112222

Tutorial topic: Sequence analysis tools
Discussion topics: plastid protein import (Box 4.1 and 4.2)

Week 3

Jan 30 Calvin Benson cycle
(Chapter 12)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-043015-111633
http://www.plantcell.org/content/28/7/tpc.116.tt0716
Feb 1 Light reactions
(Chapter 12)
http://www.plantcell.org/content/27/11/tpc.115.tt1115
http://www.plantcell.org/content/plantcell/17/3/648.full.pdf
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-050312-120129
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-050213-040226
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-042110-103811
Feb 3 Regulation of photosynthesis
(Chapter 12)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-042809-112238

Tutorial topic: Protein similarity network
Discussion topic: protein localization by fluorescent protein fusions

Week 4

Feb 6 Photorespiration and separation of assimilation from fixation
(Chapters 12 and 14)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-043015-111709
http://www.plantcell.org/content/plantcell/17/8/2139.full.pdf
https://www.sciencedirect.com/science/article/pii/S0167488906002849?via%3Dihub
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-042811-105511
Feb 8 Starch, sucrose and sugar-phosphate metabolism
(Chapter 13)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-050213-040251
Feb 10 Starch degradation, sugar-regulated gene expression
(Chapter 13)
**Take home assignment 1 on literature search (20 points)

Tutorial topic: Pymol and presentations of structure
Discussion topics: Carbohydrate structure review

Week 5

Feb 13 holiday
Feb 15 N assimilation (Chapter 7, Chapter 16)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-042817-040056
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-042811-105532
http://www.plantcell.org/content/26/12/tpc.114.tt1214
Feb 17 Regulation of N assimilation, compartmentation of amino acid metabolism, essential amino acids and herbicides
(Chapter 7, Box 7.1)

Tutorial topic: Botanical garden field trip
Discussion topics: Review take home assignment results

Week 6

Feb 20 N fixation
(Chapter 16)
Feb 22 N fixation
(Chapter 16)
Feb 24 S metabolism
(Chapter 16)
https://www.annualreviews.org/doi/abs/10.1146/annurev-arplant-042110-103921
**Take home assignment on enzyme research project (20 points)

Tutorial topic: Botanical garden field trip
Discussion topics: Plant transformation – biolistic, agrobacterium

Week 7

Feb 27 P nutrition
(Chapter 23)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-050213-035949
Mar 1 Plant lipids and fatty acid biosynthesis and elongation
(Chapter 8)
https://www.annualreviews.org/doi/full/10.1146/annurev-arplant-050718-100202
Mar 3 Unusual fatty acids, seed oils, lipid bodies, and engineering
(Chapter 8)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-043015-111641

Tutorial topic: Introduction to R
Discussion topic: Plant transformation – markers, promoters, vectors

Week 8

Mar 6 Special functions of fatty acids (photosynthesis, signaling)
(Chapter 8)
Mar 8 Isoprenoid metabolism
(Chapter 12)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-043015-111737
Mar 10 Natural products
(Chapter 24)

Tutorial topic: Transcriptomics experimental design
Discussion topic: Genome manipulation (Box 6.3 and 6.4)

Week 9

Mar 13 the cell wall – various polymers, monomers and linkages
(Chapter 2)
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-042809-112315
https://www.annualreviews.org/doi/pdf/10.1146/annurev-arplant-043015-112222
https://jcs.biologists.org/content/joces/131/2/jcs207373.full.pdf
Mar 15 the cell wall – lignin and cell wall proteins, biosynthesis
(Chapter 2)
Mar 17 developmental regulation, primary and secondary wall, cellulose synthases, suberin and cutin
(Chapter 2)

Tutorial topic: Open (responsive to student questions on data analysis)
Discussion topics: methylation analysis of cell wall polymers

Spring Break

Week 10 - Organelle and transporter topic

Mar 27 Paper 1
Mar 29 Paper 2
Mar 31 Paper 3

Tutorial topic: Q+A on papers

**Discussion topic: Papers quiz (10 points)

Week 11 – Calvin cycle and carbohydrate topic

Apr 3	Paper 4
Apr 5	Paper 5
**Apr 7	Exam 1 in class (25 points)

Tutorial topic: Q+A on papers
**Discussion topic: Paper quiz (10 points)

Week 12 – N, S, P topic

Apr 10	Paper 6
Apr 12	Paper 7
Apr 14	Paper 8

Tutorial topic: Q+A on papers
Discussion topic: review Exam 1

Week 13 – secondary metabolism, lipid topic

Apr 17	Paper 9
Apr 19	Paper 10
**Apr 21	Exam 2 in class (25 points)

Tutorial topic: Q+A on papers
**Discussion topic: Papers quiz (10 points)

Week 14 – cell wall topic

Apr 24	Paper 11
Apr 26	Paper 12
Apr 28	Review exam 2, and presentation of final exam question

Tutorial topic: Q+A on papers
**Discussion topic: Papers quiz (10 points)

****Final exam:** Research proposal on designing an engineered plant (40 points), exam will be completed (open book) during final exam period, but the question will be made available in advance and preparation for the exam may occur during RRR week.

Honor code: https://teaching.berkeley.edu/berkeley-honor-code

"As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others."

Academic Integrity:

You are a member of an academic community at one of the world's leading research universities. Universities like Berkeley create knowledge that has a lasting impact in the world of ideas and on the lives of others; such knowledge can come from an undergraduate paper as well as the lab of an internationally known professor. One of the most important values of an academic community is the balance between the free flow of ideas and the respect for the intellectual property of others. Researchers don't use one another's research without permission; scholars and students always use proper citations in papers; professors may not circulate or publish student papers without the writer's permission; and students may not circulate or post materials (handouts, exams, syllabi--any class materials) from their classes without the written permission of the instructor.

Any test, paper or report submitted by you and that bears your name is presumed to be your own original work that has not previously been submitted for credit in another course. In all of your assignments, including your homework or drafts of papers, you may use words or ideas written by other individuals in publications, web sites, or other sources, but only with proper attribution. If you are not clear about the expectations for completing an assignment or taking a test or examination, be sure to seek clarification from your instructor or GSI beforehand. Finally, you should keep in mind that as a member of the campus community, you are expected to demonstrate integrity in all of your academic endeavors and will be evaluated on your own merits. The consequences of cheating and academic dishonesty—including a formal discipline file, possible loss of future internship, scholarship, or employment opportunities, and denial of admission to graduate school—are simply not worth it.

Collaboration and Independence: Reviewing lecture and reading materials and studying for exams can be enjoyable and enriching things to do together with one's fellow students. We recommend this. Some homework assignments may be completed as a group. Please see homeworks for specific instructions.

Cheating: Anyone caught cheating on a quiz or exam will receive a failing grade and will also be reported to the University Office of Student Conduct. In order to guarantee that you are not suspected of cheating, please keep your eyes on your own materials and do not converse with others during the quizzes and exams.

Plagiarism/Self-plagiarism: You must be original in composing the writing assignments in this class. To copy text or ideas from another source (including your own previously, or concurrently, submitted course work) without appropriate reference is plagiarism and will result in a failing grade for your assignment and usually further disciplinary action. For additional information on plagiarism, self-plagiarism, and how to avoid it, see, for example
http://www.lib.berkeley.edu/instruct/guides/citations.html#Plagiarism
http://gsi.berkeley.edu/teachingguide/misconduct/prevent-plag.html

Academic Integrity and Ethics: Cheating on exams and plagiarism are examples of violations in the realm of ethics and integrity. Honesty, integrity, and ethical behavior are of great importance in all facets of life. They are so important that it is generally assumed that one has learned and internalized these qualities at an early age. As a result, these issues rarely get explicitly addressed by the time one gets to be a

university student. However, it cannot be overstated just how important honesty is to the academic enterprise.

Turnitin: As a tool to promote academic integrity in this course, written work may be checked for originality using Turnitin. Turnitin compares student work to a database of books, journal articles, websites, and other student papers. This creates an opportunity for students to improve their academic writing skills, by ensuring that other sources have been properly cited and attributed. For more information about Turnitin at UC Berkeley, visit
http://ets.berkeley.edu/academic-integrity

Statement on Classroom Climate:

We are all responsible for creating a learning environment that is welcoming, inclusive, equitable, and respectful. The expectation in this class is that we all live up to this responsibility. If you judge that these expectations are not being met, you can consult your instructors or seek assistance from campus resources.

Academic Accommodations:

The purpose of academic accommodations is to ensure that all students have a fair chance at academic success. If you have Letters of Accommodations from the Disabled Students' Program or another authorized office, please share them with me as soon as possible, and we will work out the necessary arrangements. While individual circumstances can vary, requests for accommodations often fall into the categories listed on the Academic Calendar and Accommodations website. The campus has well-developed processes in place for students to request accommodations, and you are encouraged to contact the relevant campus offices listed on the Academic Accommodations Hub(link is external). These offices, some of which are confidential, can offer support, answer questions about your eligibility and rights, and request accommodations on your behalf, while maintaining your privacy.

Scheduling Conflicts

Please notify me in writing by the second week of the term about any known or potential extracurricular conflicts (such as religious observances).

Potential papers for student presentations

Organelles

http://www.plantphysiol.org/content/plantphysiol/150/1/125.full.pdf on plant peroxisome proteomics

https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-313X.2008.03702.x on production of proteins in chloroplast

Calvin cycle

https://www.nature.com/articles/nplants20142/fig_tab on degradation of Rubisco inhibitor

http://www.plantcell.org/content/plantcell/17/8/2413.full.pdf on glycerate kinase in photorespiration

Carbohydrate metabolism and transporter

https://science.sciencemag.org/content/sci/303/5654/87.full.pdf maltose transporter for starch degradation

Secondary metabolism, engineering

https://science.sciencemag.org/content/sci/287/5451/303.full.pdf on engineering provitamin A into rice

Fatty acids, lipids

https://www.pnas.org/content/pnas/93/16/8771.full.pdf on a desaturase required for pest resistance in geranium

http://www.plantcell.org/content/plantcell/21/3/892.full.pdf on UDPGlc pyrophosphorylase in sulfolipid synthesis

Cell walls

http://www.plantcell.org/content/plantcell/15/2/523.full.pdf on L-arabinose synthesis for cell walls

https://www.pnas.org/content/pnas/99/11/7797.full.pdf on xylosyltransferases for xyloglucan synthesis

https://onlinelibrary.wiley.com/doi/pdf/10.1111/tpj.12135 on glucuronoxylans

https://www.nature.com/articles/s41477-018-0217-7.pdf?origin=ppub on novel rhamnosyltransferase