HOS 6932 Plant Biochemistry

Spring, 2026
Format: In-person, 4 Credits

Instructors

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Teaching Assistant

None.

Course Description

Biochemical principles underlying regulation of plant metabolism, biosynthetic processes, and stress responses, together with AI prediction and modeling of protein structure. Integrated concepts include metabolic micro-environments in plants, photosynthesis, C/N balance, specialized plant products, quantitative analysis of enzyme kinetics, metabolic flux analysis, and regulatory signals with emphasis on their organismal context.

Course Learning Objectives

Plant Biochemistry students will:

1) construct structural models of proteins and protein complexes using AI
2) assess accuracy of predicted protein structures
3) analyze thermodynamics of enzyme catalysis
4) predict plant metabolic responses to light, nutrients and environmental stress
5) appraise roles of metabolic micro-environments and metabolic signaling in an organismal context
6) critically evaluate strategies for climate-proofing plants through biochemical adaptations to biotic and abiotic stresses
7) categorize enzymes in pathways of plant primary and specialized product metabolism
8) analyze enzyme kinetic and ligand binding data using R
9) compare and contrast metabolic control analysis and flux balance approaches to modeling metabolism

Course Overview and Purpose

The overall purpose of Plant Biochemistry is to equip students with essential knowledge and skills in biochemistry needed to support collaborative, interdisciplinary research in biotechnology, synthetic biology, molecular plant breeding, functional genomics, stress biology and post-harvest physiology.

Course Prerequisites

None.

Textbooks, Learning Materials, and Supply Fees

Recommended reading:

Araus, J.L., Sanchez-Bragado, R. and Vicente, R., (2021) Improving crop yield and resilience through optimization of photosynthesis: panacea or pipe dream?. *Journal of experimental botany*, *72*(11), pp.3936-3955.

Biochemistry & Molecular Biology of Plants, 2nd edition, print or electronic version, 2015, Wiley Blackwell (Still the best in 2025. About $120 new, much less if used. Great visuals and explanations.

Abramson, J., Adler, J., Dunger, J. *et al.* (2024). Accurate structure prediction of biomolecular interactions with AlphaFold 3. *Nature* **630**, 493–500. doi:10.1038/s41586-024-07487-w

Changeux, J-P. (2012). Allostery and the Monod-Wyman-Changeux Model After 50 Years. Annu. Rev. Biophys. 2012. 41:103–33. Doi:10.1146/annurev-biophys-050511-102222.

Modeling plant metabolism:

David Fell, Understanding control of metabolism. Portland Press. (out of print). Public domain pdf included in course notes.

Orth, J., Thiele, I. & Palsson, B. What is flux balance analysis? (2010). *Nat Biotechnol* **28**, 245–248. doi:doi.org/10.1038/nbt.1614

Comparing strategies for molecular alteration of photosynthesis:

South PF, Cavanagh AP, Liu HW, Ort DR. (2019) Synthetic glycolate metabolism pathways stimulate crop growth and productivity in the field. Science. Jan 4;363(6422):eaat9077.

Lu KJ, Hsu CW, Jane WN, Peng MH, Chou YW, Huang PH, Yeh KC, Wu SH, Liao JC. (2025) Dual-cycle CO_2 fixation enhances growth and lipid synthesis in Arabidopsis thaliana. Science. Sep 11;389(6765):eadp3528.

Instructor Interaction Plan

None.

Required Technology & How to Obtain the Technology

Each student should have a laptop or desktop computer.

Technical skills

None.

Digital information literacy skills

None.

Communication Guidelines

None.

Class Demeanor/Expectations

Class participation is encouraged.

General Education or Quest or Writing Objectives and Student Learning Outcomes

Not applicable.

Technical Support

UF Computing Help Desk & Ticket Number: All technical issues require a UF Helpdesk Ticket Number. The UF Helpdesk is available 24 hours a day, 7 days a week. https://helpdesk.ufl.edu/ | 352-392-4357

Weekly Course Schedule

Course schedule Spring 2026

January	Day	Lecture topic	Instructor
12	M	Amino acids: Keys to protein structure and function	DM
13	T	Fundamentals of protein structure	DM
14	W	AI prediction and modeling of protein structure - AlphaFold3	DM
15	Th	Exploiting protein diversity for separation and purification	DM
19	M	no class MLK Holiday	
20	T	Proteomics analysis	DM
21	W	Thermodynamics of enzyme catalysis	DM
22	Th	Enzyme mechanisms	DM
26	M	Movers and shakers: Molecular motors couple ATP to motion	DM
27	T	AlphaFold3 project discussion and review	DM
28	W	Exam 1	DM
29	Th	Strategies for enhancing photosynthesis? The big picture	KK
February			
2	M	Sink strength regulates photosynthetic genes	KK
3	T	Sugar sensing and signaling in sources and sinks	KK
4	W	Vulnerabilities of photosynthetic thylakoid systems and +H gradients	KK
5	Th	Metabolites as signals: Critical analysis	KK
9	M	Critical roles of antioxidants, redox reactions, protective systems	KK
10	T	Engineering photosynthesis: Questions of balance and interaction	KK
11	W	The quest for C4 rice, engineering CAM, and roles of C/N balance	KK
12	Th	Altering NO3, NO2, and NH3 assimilation? Benefits? Hazards?	KK
16	M	Phloem biochemistry: Transporters, sugars, metabolism, and water	KK
17	T	Exam 2	KK
18	W	Designer starch, fructans, and polysaccharides	KK
19	Th	Altering polysaccharides: Cell walls and beyond	KK
23	M	Glycolysis and endogenous low-oxygen micro environments	KK
24	T	Critical analysis of respiratory perturbation: Genetic, abiotic, other	KK
25	W	Oxidative pentose phosphate pathway	KK
26	Th	Mitochondrial functions: GABA, Glyoxylate, and Citric-acid cycles	KK
March			
2	M	Mitochondrial functions: Electron transport	KK
3	T	Vulnerabilities of respiratory cristae, H2O2, and links beyond	KK
4	W	Exam 3	KK
5	Th	Fatty acid desaturation	SR
9	M	Fatty acid synthesis I	SR
10	T	Fatty acid synthesis II	SR
11	W	Fatty acid oxidation I	SR
12	Th	Fatty acid oxidation II	SR
16-19	M-Th	no class spring break	
23	M	Health-promoting secondary products	SR
24	T	CBDs	SR
25	W	Flavonoids	SR
26	Th	Phenolics and ESPS synthase	SR
30	M	Terpene synthesis	SR
31	T	Carotenoids	SR
April			
1	W	Alkaloids I	SR
2	Th	Alkaloids II	SR
6	M	Exam 4	SR
7	T	Thermodynamics of ligand binding to proteins	DM
8	W	Analysis of saturable binding to non-interacting sites	DM
9	Th	Fitting binding equations by non-linear least squares	DM
13	M	Interacting sites: Hill and Monod-Wyman-Changeux models	DM
14	T	Equilibrium and steady-state enzyme kinetics	DM
15	W	Allosteric enzymes: cooperative kinetics	DM
16	Th	Metabolic Control Analysis: kinetics applied to pathways	DM
20	M	Flux Balance Analysis: systems modeling of metabolism	DM
21	T	Discussion and review	DM
22	W	Exam 5	DM
23	Th	no class, Reading day	

Grading Policy

Course grading is consistent with UF grading policies.

Course Grading Structure

Plant Biochemistry includes 5 modules awarded 100 p

Assignment Type	Point Value	Percent of Final Grade
Module 1 Exam	70	14
Module 1 Homework	30	6
Module 2 Exam	70	14
Module 2 Presentation	30	6
Module 3 Exam	70	14
Module 3 Activity	30	6
Module 4 Exam	70	14
Module 4 Quiz/homework	30	6
Module 5 Exam	70	14
Module 5 Homework	30	6
Total	500	100

Grading Scale

Grade	Points	Percentage
A	4.0	92.0-100
A-	3.67	87.0-91.99
B+	3.33	83.0-86.99
B	3.0	79.0-82.99
B-	2.67	73.0-78.99
C+	2.33	69.0-72.99
C	2.0	65.0-68.99
C-	1.67	60.0-64.99
D+	1.33	55.0-59.99
D	1.0	53.0-54.99
D-	0.67	50.0-53.99
F	0	0.0-49.99

Academic Policies and Resources

Academic policies for this course are consistent with university policies. See https://syllabus.ufl.edu/syllabus-policy/uf-syllabus-policy-links/

Campus Health and Wellness Resources

Visit https://one.uf.edu/whole-gator/topics for resources that are designed to help you thrive physically, mentally, and emotionally at UF.

Please contact UMatterWeCare for additional and immediate support.

Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Privacy and Accessibility Policies

[required for online courses, list all technology used]

- Instructure (Canvas)
  - Instructure Privacy Policy
  - Instructure Accessibility
- Zoom
  - Zoom Privacy Policy
  - Zoom Accessibility

Additional information