

**HORT 64000 (CRN 27936) / BCHM 64000 (CRN 27935)**  
**Metabolic Plant Physiology (3 credits)**  
Fall 2025 Syllabus

Tuesdays and Thursdays (face-to-face)  
1:30 - 2:45 PM, Fall Semester

Prerequisite(s): HORT 30100 - Plant Physiology, or equivalent

**Textbook:**

"Biochemistry and Molecular Biology of Plants, Second Edition" (Buchanan BB, Grissem W, Jones RL), American Society of Plant Biologists, Rockville, MD, 2015

**Course Description**

This 3-credit, 15-week course will be taught by Drs. Natalia Dudareva and Josh Widhalm. Students will be introduced to basic principles of plant metabolism including the mechanisms of uptake of small molecules from the environment and their elaboration into increasingly more complex structures via primary and secondary metabolism. A major emphasis will be placed on plant carbon metabolism (photosynthesis, respiration, lipid biosynthesis, carotenoid and terpenoid biosynthesis), nitrogen, sulfur and secondary metabolism in plants, and interconnections between these metabolic networks. The course will introduce students to the various tiers of regulation of these pathways and efforts to genetically engineer them to enhance plant productivity, increase plant stress tolerance, and improve nutritional quality and economic value of harvested organs.

**Learning Outcomes**

By the end of this course, students should be able to:

- Describe the primary plant metabolic pathways and the regulatory mechanisms involved in the biochemical pathways associated with plant growth and development
- Describe the contributions of different organelles to plant metabolism
- Describe the role of specialized metabolism in plant physiological responses to abiotic stresses and in plant-biotic interactions
- Critically analyze primary research articles related to plant metabolism, identifying key questions, methodologies, and conclusions.
- Synthesize information from primary scientific literature to develop and deliver effective scientific presentations.

## Grading

The course grade will be determined by a combination of assignments, individual and team presentations, participation during discussion of assigned papers, and a final mini-symposium presentation for a maximum total of 450 points, distributed as follows:

Date	Subject	Points (450)*
09/09/25	Discussion 1 (Prywea <i>et al.</i> , 2025)	25
09/16/25	Discussion 2 (Swift <i>et al.</i> , 2024)	25
09/18/25	Presentation 1: Strategies for Genetic Manipulation of Photosynthesis (team presentations)	50
09/23/25	Discussion 3 (Seydel <i>et al.</i> , 2025)	25
09/30/25	Discussion 4 (Zmuda <i>et al.</i> , 2024)	25
10/07/25	Discussion 5 (Yang <i>et al.</i> , 2025)	25
10/09/25	Presentation 2: Genetic Engineering of Lipids (team presentations)	50
10/21/25	Discussion 6 (Liu <i>et al.</i> , 2022)	25
10/28/25	Discussion 7 (H. Liu <i>et al.</i> , 2025)	25
11/04/25	Discussion 8 Discussion 4 (Rekhter <i>et al.</i> , 2019; Torrens-Spence <i>et al.</i> , 2019)	25
11/11/25	Discussion 9 (Y. Liu <i>et al.</i> 2025; Zhu <i>et al.</i> 2025; Wang <i>et al.</i> 2025)	25
11/18/25	Discussion 10 (Henry <i>et al.</i> , 2018; Gutensohn <i>et al.</i> , 2021)	25
11/20/25	Discussion 11 (Colinas <i>et al.</i> , 2025)	25
12/02-11/25	Mini-symposium presentations	100

**\*Lowest Discussion grade will be dropped**

Students scoring a total score of 403 - 450 points will be given a grade of A, further sub-divided as follows (note: revisions due to miscalculation are noted in red):

- 435-450 = A+ (97-100%)
- 417-434 = A (93-96%)
- 403-416 = A- (90-92%)

Students scoring a total of 358 - 402 points will be given a grade of B, further sub-divided as:

- 390-402 = B+ (87-89%)
- 372-389 = B (83-86%)
- 358-371 = B- (80-82%)

Students scoring a total of 313 - 357 points will be given a grade of C, further sub-divided as:

- 345-357 = C+ (77-79%)
- 327-344 = C (73-76%)
- 313-326 = C- (70-72%)

Students scoring a total of 268 - 312 points will be given a grade of D, further sub-divided as:

- 300-312 = D+ (67-69%)
- 282-299 = D (63-66%)
- 268-281 = D- (60-62%)

Students scoring a total 267 points or lower will be given a grade of F:

- Less than or equal to 267 = F

## Assignments

**Discussions (250 points):** Students will earn 25 points for each of the scheduled discussions. For each assignment, students will be assigned one of the following elements to present as part of the larger discussion:

1. Outlining the scientific background, identifying the knowledge gap, and clearly stating the central question and hypothesis of the study;
2. A major experiment or figure from the paper, describing the rationale, methods, data interpretation, and the main conclusions, and providing a brief evaluation of the authors' interpretation;
3. Summarizing the study's key conclusions, assessing whether the data supports these conclusions, discussing the strength of the evidence, and considering alternative explanations;
4. Identifying limitations, unanswered questions, or missing elements in the study.

There will be 11 discussions, but only the ten highest grades will factor into the 250 total points available. Given this built-in flexibility to miss one discussion, there will be NO opportunities to make up participation points without an approved absence by the Office of the Dean of Students. Students may make up points at our discretion without an approved absence.

**Team presentations (100 points):** Working in teams of three, students will choose a manuscript and present on the reported strategies to genetically/metabolically manipulate photosynthesis (Week 4) or lipid metabolism (Week 7). Each assignment is worth 50 points. Each team will make a 15-minute PowerPoint presentation with an additional 2-5 minutes for questions and discussion. The presentation should include:

- A brief introduction that states the goals and hypothesis tested,
- A description of the metabolic modifications performed,
- A brief description of obtained results, an explanation in the case of an unexpected outcome, and possible future experiments to achieve the initial goal.

**Mini-symposium (100 points):** Each student will be required to give a 15-minute presentation (12 minutes for the talk and 3 minutes for questions) on an application related to any aspect of plant metabolism or an example of translating knowledge of plant metabolism for developing a practical product. Example topics include, but are not limited to, the use of plant metabolites or the manipulation of plant metabolism for pest management (e.g., new herbicide technology), improving agronomic traits (e.g., yield, post-harvest handling and storage, etc.), enhanced consumer traits (e.g., fruit flavor, appearance, etc.), or human health (e.g., nutrition, medicine, etc.). Efforts may include attempts to manipulate endogenous metabolism or to create new pathways to produce novel metabolites. Regardless of topic, students should provide background information on the problem being addressed, describe the long-term goal and/or hypothesis driving the research, and incorporate elements from the course to describe the solution, including describing (i) the metabolism (e.g. associated biosynthesis pathways, transport, regulation, etc.); (ii) the efforts made to manipulate the metabolism via metabolic

engineering, breeding, or other approaches; and (iii) the outcomes of the work. A rubric with additional details about expectations for the presentation will be provided. This assignment is worth 100 points.