Plant Biology Department, CNS

Plant Physiology: PLB 415

Spring 2022

PART I – Course Information

Instructor:

Professor: Luke M. Gregory
Email: grego215@msu.edu
Office: Room 310, 612 Wilson Rd, East Lansing MI, 48824

Class Meeting Times:

When: Monday, Wednesday, and Friday from 10:20 - 11:10am
Where: Plant Biology Laboratories, room 247

Course Description:

This course serves as an introduction to plant physiology for third- and fourth-year undergraduate students in the plant biology department, though it is open to anyone wanting a comprehensive understanding of plant physiology. The curriculum balances molecular and ecological aspects of plant physiology, covering three main themes: *Transport and Translocation of Water and Minerals*, *Biochemistry and Metabolism*, and *Growth and Development*. Adopting a "molecules to ecosystems" approach, students will get an in-depth understanding of water transport, mineral nutrition, photosynthesis, plant primary metabolism, key plant developmental processes, and the action of plant hormones all in the context of both abiotic/biotic factors.

In addition to the lectures, a quantitative understanding of plant systems and the physiological processes covered in the course will be emphasized through a series of problem sets and in-class exercises. A complementary laboratory course (PLB 415-01/02) provide hands-on experiences to these topics.

Prerequisite:

This course requires a working knowledge of algebra (i.e., comfort with working with and manipulating equations) and previous knowledge of molecular biology and cell biology.

Course Goals and Learning Objectives:

Course Goal: This course is designed to provide students with a foundational understanding of the fundamental concepts in plant physiology. Cooperative learning and quantitative reasoning exercises will equip students with higher-order skills (i.e., quantitative reasoning, interdisciplinary thinking, working with multicultural teams) preparing them to thrive in our data-rich and interconnected world.

Learning Objectives: Given that the topics covered in this course build on each other, students should develop the listed learning outcomes as the course progresses. By successfully completing this course, you will be able to …

- Identify how plants use innovative approaches for acquiring and retaining water.
- Explain (at the cellular- and molecular- level) how different macro- and micro-nutrients effect plant growth and development. Scale the impact of micro-scale nutrient deficiencies to whole-plant physiology.
- Outline how environmental growth conditions (temperature, light, CO_2, O_2) effect the efficiency of photosynthesis.
- Diagram the journey/metabolism of a molecule of CO_2 from the atmosphere to starch/sucrose and explain using the diagram how photosynthetic leaves spend their carbon income in the day and at night.
- Understand at the molecular level how plant hormones are perceived, transduced, and their effect at the macro-scale (whole-plant).
- Propose plant care practices that tie in one or more physiological mechanism you have learned in this course.

AND, STUDENTS SHOULD GENERALY BE CAPABLE OF…

- Generating *"defensible explanations"* to describe plant physiological phenomenon by…
  - …conceptualizing and constructing various plant systems (i.e., from whole-plant to organelle-level) and plant physiological processes.
  - …developing and revising mathematical models to explain a biological systems and phenomenon .
  - …deploying biological models to make predictions about plant processes.
  - …determining trends in data and defending them with biological arguments.
- … participate effectively in cooperative learning exercises with collaborative teams to solve challenging questions in plant physiology discipline.

PART 2 – Course Organization

Course Structure and Requirements

The course lessons will be delivered in-person through a classroom setting. All course assignments will be posted to an online course management system, and you will need your MSU NetID to login to the course from the D2L homepage (http://d2l.msu.edu). In D2L, you will access course materials, activities, and additional resources. Activities may consist of readings, discussion forums, assignments, projects, email, and other online activities.

- *Flipped Classroom Design*: To maximize the time we can dedicate to mastering key concepts, we will practice a flipped classroom model as much as possible. This means that you will be responsible for watching short videos and read the textbook and/or supplemental literature outside of the classroom.
- *In-Class Activities*: During class, you will collaborate with small groups to work through high-level case studies. There will be three case studies throughput the semester, each corresponding to one of the three main themes (i.e., *Transport and Translocation of Water and Minerals*, *Biochemistry and Metabolism*, and *Growth and Development*).
- *Quantitative Reasoning exercises*: You will have the opportunity to apply quantitative reasoning skills to describe and make predictions about various plant

systems and biological phenomena. This will be emphasized through problems sets that correspond with in-class activities.

Emailing with questions regarding the course

1. Be sure to direct all your questions to the course instructors
2. Please include “PLB 415” in the subject line
3. Be clear about your intentions for a timely and organized response
4. Additionally, you could use the Discussion Forum to post questions on the course. These will be discussed at the Weekly Q&A Session

Student Responsibility

Study at MSU places a premium on self-motivation, the instructor will provide information, exercises, and oversee discussions and debate designed to help you learn concepts and skills related to scientific reasoning. You will be responsible for making the most of these resources and seeking to understand both the knowledge base and the scientific practices in biology.

- **Group Work**
  - Group study can significantly enhance your learning experience. You are encouraged to study for exams in groups but the exams themselves will be completed individually. You are encouraged to discuss the quantitative exercises with each other, but each student must write out their answers independently.
- **Generative AI**
  - The intellectual growth you can get from working through a difficult problem and discovering the answer for yourself cannot be replicated by reading a pre-generated answer. That being said, the use of generative AI is permitted in this course for students who wish to use these tools.
  - *Use-cases include:* proof-reading text, generating ideas or brainstorming, writing code, improving accessibility, help with data analysis.
  - To be consistent with our scholarly values, students must cite any AI generated material that informs their work. Transparency is key when working with these tools.
- **How to do well!**
  - Focus on the learning objectives
  - Stay engaged, especially during the in-class exercise(s)
  - Seek help from your peers or the instructor

PART 3 – Course Schedule

***Important Note:** Refer to the course calendar for specific meeting dates and times. Activity and assignment details will be explained in detail within each week's corresponding learning module. If you have any questions, please contact the instructor.

COURSE SCHEDULE

The table below describes the weekly activities including week, topic, activities, and due date. The first column describes the week. The second column describes the topic. The third column describes the activities. The fourth column describes the due date for the cooperative learning exercises. The additional reading material for each week are built into the mini lessons.

Week	***Date***	***Topic***	***Activities***	*Due Date*
1	*Jan. 10*	*Plant and Cell Architecture & Introduction to Plant Fluxes*	Cooperative Learning Exercise (Module 1) **Textbook**: Chapter 1 (pg5-29) **Quantitative Exercise**: Plant flux & unit conversion	Sunday, Jan. 31 (11:59 pm)
2	*Jan. 17*	*Water Balance*	**Textbook**: Chapter 4 (pg101-117), & Chapter 11 (p285-292, 295-297) **Quantitative Exercise**: Plant-Water Relations	
3	*Jan. 24*	*Mineral Nutrition*	**Textbook**: Chapter 5 **EXAM 1 (F)**	
4	*Jan. 31*	*Fundamentals of Photosynthesis (Light Reactions)*	Cooperative Learning Exercise (Module 2) **Textbook**: Chapter 7 (pg171-195) **Quantitative Exercise**: Modelling Linear Electron Flow	Sunday, Mar. 14 (11:59 pm)
5	*Feb. 7*	*Fundamentals of Photosynthesis (Calvin-Benson Cycle)*	**Textbook**: Chapter 8 (pg203-208, 210-217) **Quantitative Exercise**: CO_2 and H_2O Gas-Exchange	
6	*Feb. 14*	*Photosynthesis and the Environment*	**Textbook**: Chapter 9 **Quantitative Exercise**: Temperature Response	
7	*Feb. 21*	*Plant Central Metabolism*	**Textbook**: Chapter 12	

Week	***Date***	***Topic***	***Activities***	*Due Date*
			Quantitative Exercise: Enzyme Activity	
8	*Feb. 28*	*Plant Central Metabolism*	**Textbook**: Chapter 12 **EXAM 2 (F)**	
9	*Mar. 14*	*Plant Growth/ Development Principles*	Cooperative Learning Exercise (Module 3) **Quantitative Exercise**: Crop Growth Rate	Sunday, Apr. 18 (11:59 pm)
10	*Mar. 21*	*Plant Signal Transduction*	**Textbook**: Chapter 16	
11	*Mar. 28*	*Plant Hormones*	**Textbook**: Chapter 16 **Quantitative Exercise**: Auxin signaling	
12	*Apr. 4*	*Plant Hormones*	**Textbook**: Chapter 16	
13	*Apr. 11*	*Plant Hormones*	**Textbook**: Chapter 16	
14	*Apr. 18*	*Plant Adaptation and Acclimation*	**Textbook**: Chapter 9	
15	*Apr. 25*	*Final*	**EXAM 3 (F)**	

Late work Policy:

We recognize that we all have busy lives and there are times we fall behind on submitting assignments. However, it is also important that we discipline ourselves to submit assignments on time to maintain professionalism. During the 14 WEEK course, you will have no more than **2 opportunities** to request for a late submission. Given the topics build on each other, you would get up to 2 extra days from the deadline to submit the assignments. To request a late pass, you are required to email the instructor/course assistant prior to the weekly assignment deadline.

PART 4 – Grade Policy

Grading: Course grades will be assigned according to the following scale:

Grade	Percentage Earned
4.0	≥ 90%
3.5	≥ 85%
3.0	≥ 80%
2.5	≥ 75%
2.0	≥ 70%
1.5	≥ 65%
1.0	≥ 60%
0.0	≤60%

Your grades in the course will be based on the following:
Exam: 60 %
Quantitative Exercises: 40%

Exams:
- There will be three exams in this course
- Exams will be short answer and some questions will require longer answers.

Quantitative Exercises:
- These exercises are meant to be challenging, but students will have the opportunity to work on them in groups
- Completion grade will be given, and exercises will be worked through as a class each Friday

PART 5 – Course Policies

Diversity Equity and Inclusiveness
Diversity, Equity and Inclusion are important, interdependent components of everyday life in the College of Agriculture and Natural Resources (CANR) and are critical to our pursuit of academic excellence. Our aim is to foster a culture where every member of CANR feels valued, supported and inspired to achieve individual and common goals with an uncommon will. This includes providing opportunity and access for all people across differences of race, age, color, ethnicity, gender, sexual orientation, gender identity, gender expression, religion, national origin, migratory status, disability / abilities, political affiliation, veteran status and socioeconomic background. (See the full CANR statement: https://www.canr.msu.edu/news/canr-statement-on-diversity-equity-and-inclusion)

Commit to Integrity: Academic Honesty
Article 2.3.3 of the Academic Freedom Report states that "The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards." In addition, the Plant, Soil and Microbial Sciences Department adheres to the policies on academic honesty as specified in General Student Regulations

1.0, Protection of Scholarship and Grades; the all-University Policy on Integrity of Scholarship and Grades; and Ordinance 17.00, Examinations. (See Spartan Life: Student Handbook and Resource Guide and/or the MSU Web site: www.msu.edu.)

Therefore, unless authorized by your instructor, you are expected to complete all course assignments, including homework, lab work, quizzes, tests and exams, without assistance from any source. You are expected to develop original work for this course; therefore, you may not submit course work you completed for another course to satisfy the requirements for this course. Also, you are not authorized to use the www.allmsu.com Web site to complete any course work in this course. Students who violate MSU academic integrity rules may receive a penalty grade, including a failing grade on the assignment or in the course. Contact your instructor if you are unsure about the appropriateness of your course work. (See also the Academic Integrity webpage.)

Complete Assignments
Assignments for this course will be submitted electronically through *D2L* unless otherwise instructed**.** Assignments must be submitted by the given deadline or special permission must be requested from instructor before the due date. Extensions will not be given beyond the next assignment except under extreme circumstances.