

BIO 351: Plant Physiology

Fall 2017, 4 Credits

Lecture: M, W 2:00 – 3:15 PM

Lab: Thurs. 2 – 4:50

Lecture Instructor: Ann Impullitti, Ph.D.

Office: TNR 445

Work Phone: 715-346-2772

Email: ann.impullitti@uwsp.edu (this is the best way to reach me)

Office hours: 9:30 – 11:30 M, W or by appointment

In general, I have an open door policy. If you have any questions stop by any time and I will answer them, time permitting

How I will contact you: I will use your UWSP email address so please check your email daily. If you use a different email address, make arrangements to have messages forwarded to the account you use.

Introduction

Plant Physiology is the study of how plants function. The course will largely focus on angiosperms (flowering plants), but many of the same concepts can be applied to bryophytes, seedless vascular plants, and gymnosperms. The course will introduce you to most of the basic process required for plant function, such as photosynthesis, water relations in the cell and whole plant, growth, and development. We will also discuss various biotic and abiotic factors that influence plant physiology, and themes of plant biotechnology and plants and people will be discussed throughout the course.

At the completion of this course you should be able to:

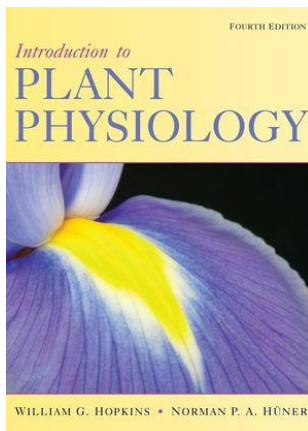
- 1) Demonstrate an understanding of how plants manufacture biological molecules
 - a. Explain the physical nature of light and its importance to photosynthesis
 - b. Explain how plants respond to light (photoreceptors and phytochromes)
 - c. Explain how plants harvest light and produce ATP and NADPH for carbon reduction
 - d. Explain how plants reduce carbon dioxide to organic carbon
 - e. Summarize cellular respiration and explain how plant respiration is different than animal respiration
- 2) Demonstrate how plants acquire and transport water and solutes for growth
 - a. Explain the structure and properties of water
 - b. Demonstrate understanding of the uptake and transport of water (whole plant and plant cells)
 - c. Identify macro and micronutrients required by plants
 - d. Identify plant nutrient deficiencies and explain how they could be rectified
 - e. Explain mechanisms for procurement and transport of nutrients by plants
 - f. Demonstrate an understanding of the importance of bacteria and fungi in nitrogen and phosphorous acquisition.
 - g. Explain the translocation of photoassimilates in the phloem
- 3) Demonstrate an understanding of how plants grow and develop
 - a. Describe the organization of plants from cells to organ systems
 - b. Examine plant development from embryo to adult (embryogenesis, seed dormancy, seed germination). Cell wall, structure, and growth will be discussed
 - c. Demonstrate an understanding of the major effects and physiological mechanisms of growth regulators (hormones) in plants

- d. Explain various photoperiod responses by plants, and how flowering and fruit development are initiated
- 4) Demonstrate and understanding of how plants interact with their environment
 - a. Describe alternate carbon fixation pathways (CAM and C4)
 - b. Predict how the environment might impact photosynthetic processes
 - c. Explain constitutive and induced defense responses to pathogens, herbivores, and insects
 - d. Explain how plants acclimate or adapt to drought, heat, cold, salinity or other possible stressors
- 5) Demonstrate an appreciation of how plant physiology relates to other fields in biology
- 6) Explain how plant physiology will shape the future
 - a. Biotech industry, plants and plastics/fuels, phytoremediation, vaccines, drugs

Course Materials

For lecture

Textbook: Hopkins, W.G. *Introduction to Plant Physiology*, 4th edition. Sinauer Associates, Inc. Wiley
 ISBN: 978-0-470-24766-2



For Lab

Lab Manual: I will supply lab handouts

Student expectations and attendance

I will not formally take attendance in lecture, but you are expected to attend all lectures. Furthermore, I am up front of you every day, meaning that I see and look at my audience daily and will know if you are not in attendance on a regular basis. Please note that there is also a strong correlation with attendance and being successful as an undergraduate.

Attendance in lab is mandatory. You must notify me at least one week prior to an excused event (university sponsored activity, religion holiday, etc) in order for the lab to be considered excused. Make-up labs are not possible even for excused absences. Inclement weather and oversleeping are two examples of unexcused absences. If you have an unexcused absence you may be able to study the lab material on your own time, but you will not receive points for the lab (or abstract). **An unexcused absence will reduce your grade by half of a letter grade (i.e. B → B-); two unexcused labs will result in a full letter grade deduction.**

Assessment

Exams (300 pts)

- Three in class exams (100 pts/exam). Exams are based on lectures and labs. Exams may be composed of T/F, multiple choice, fill in the blank, short answer, data interpretation, problem solving, and essay.
 - A makeup exam will be given if you have a conflict due to a religious observance or an UWSP sponsored event. In cases such as these, you need to make arrangement with me **at least 1 week before the exam.** **The rescheduled test must be taken 24hrs before the scheduled time. NO EXCEPTIONS**
 - If you miss an exam for any other reason (car troubles, illness, family emergency, alarm clock failure, etc.), you will receive a zero on the exam. This zero will be replaced with the percentage you earn on the final exam. For example, you missed lecture exam #1 and earned a 75% (112.5/150pts) on the final exam. Exam #1 will now be replaced with 75pts.

Final Exam (150 pts)

- The final exam is cumulative. Biology is a discipline in which you are constantly building on prior knowledge, and therefore on the final you will be expected to integrate concepts and ideas from throughout the semester.

Abstracts and Supporting documents (Lab) (300 pts)

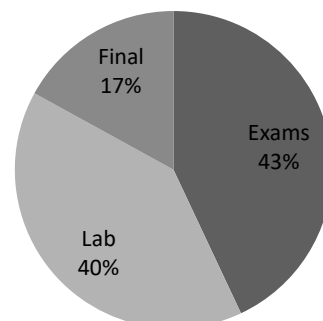
- Lab exercises will require an abstract with attached figures, data tables, and/or diagrams as documentation. The completed abstract is due on the date announced in class. You will be required to turn in all of the abstracts, but you will be randomly selected from the stack a total of 10 times for grading. (10 x 30 pts)
More details will be supplied in lab
- Late abstracts will receive penalties...so turn these in promptly. Early submissions are encouraged

Membrane Permeability and water potential
Plant Pigments
Mineral Nutrition
Stomata
Photosynthesis: C3 vs C4
Photosynthesis: Light vs Sun
Respiration
Group Photosynthesis Experiment

Bean Branch Initiation
Root Initiation
Light Seed Germination
Light and Stem Growth
Pea Stem Growth
Chloroplast Isolation and Fractionation
Developmental Changes during Germination

Grading

A	>93%	> 697.5
A -	90 - 92.9%	675 - 697
B+	87 - 89.9%	652 - 674
B	83 - 86.9%	622 - 651
B-	80 - 82.9%	600 - 621
C+	77 - 79.9%	577 - 599
C	73 - 76.9%	547 - 576
C-	70 - 72.9%	525 - 546
D+	67 - 69.9%	502 - 524
D	63 - 66.9%	472 - 501
D-	60 - 62.9%	450 - 471
F	<59.9	> 450



UWSP Policies

Academic Integrity: Academic dishonesty in any form will not be tolerated! It is your responsibility to be aware of your rights and responsibilities as a UWSP student. Please take the time to read and understand the information found here (and let me know of any questions):

<http://www.uwsp.edu/dos/Documents/CommunityRights.pdf>. Cheating or plagiarism related to any of the course assessments will result in a score of zero for that assessment.

Accommodations

UWSP is committed to providing reasonable and appropriate accommodations to students with disabilities and temporary impairments. If you have a disability or acquire a condition during the semester where you need assistance, please contact the Disability and Assistive Technology Center on the 6th floor of Albertson Hall (library) as soon as possible. DATC can be reached at 715-346-3365 or DATC@uwsp.edu.

Emergency Services

You should review and understand UWSP emergency procedures.

<http://www.uwsp.edu/rmgt/Pages/em/procedures/default.aspx>

BIO351: Plant Physiology Lecture and Lab Schedule

Week 1	Topic	Reading
Wed-Sep-6	What is plant physiology Review of Plant Structure and Organelles	
Thu-Sep-7	Lab #1: Basic statistics Computers needed!	
Week 2		
Mon-Sep-11	Water Relations of Plant Cells	Ch 1: 1.1 - 1.11
Wed-Sep-13	Water Relations of Plant Cells Cont. Whole Plant Water Relations: Soil → Roots → Stems → Leaves → Atmosphere	Ch 2: 2.1 - 2.9
Thu-Sep-14	Lab #2: Water Relations of Plant Cells (Membrane Permeability and Water Potential)	
Week 3		
Mon-Sep-18	Whole Plant Water Relations: Soil → Roots → Stems → Leaves → Atmosphere	Ch 2: 2.1 - 2.9
Wed-Sep-20	Nutrient Acquisition	Ch 3: 3.1 - 3.7
Thu-Sep-21	Lab #3: Begin mineral nutrition lab Begin tissue culture lab (African violets)	

Week 4		
Mon-Sep-25	Nutrient Acquisition Cont. and Mineral Nutrition	Ch 3: 3.1 - 3.7; Ch 4: 4.1 - 4.2, 4.4
Wed-Sep-27	Nitrogen Assimilation	Ch 3: 3.9; Ch 11: 11.1 - 11.9
Thu-Sep-28	Lab #4: Introduction to the LI-6400	
Week 5		
Mon-Oct-2	Exam #1	
Wed-Oct-4	Overview of Metabolism and Plant Energetics	Ch 5: 5.1 - 5.3
Thu-Oct-5	Lab #5: Plant Pigments	
Week 6		
Mon-Oct-9	Light Reactions: Sunlight and Pigments	Ch 6: 6.1 - 6.3
Wed-Oct-11	Light Reactions	Ch 7: 7.1 - 7.1
Thu-Oct-12	Lab 6: Stomata Finalize mineral nutrition observations (at your convenience)	
Week 7		
Mon-Oct-16	Stomata, Gas exchange, and Carbon Fixation Reactions	Ch 8: 8.1 - 8.7
Wed-Oct-18	Stomata, Gas exchange, and Carbon Fixation Reactions	Ch 8: 8.1 - 8.7
Thu-Oct-19	Lab #7: Photosynthesis: C3 vs C4; Sun vs Shade	
Week 8		
Mon-Oct-23	Respiration	Ch 10: 10.1 - 10.13
Wed-Oct-25	Plant Responses to the Environment	Ch 13: 13.1 - 13.7
Thu-Oct-26	Lab #8: Your own photosynthesis experiments	
Week 9		
Mon-Oct-30	Plant Responses to the Environment	Ch 14: 14.1 - 14.6
Wed-Nov-1	Plant Responses to the Environment	Ch 15: 15.1 - 15.5
Thu-Nov-2	Lab #9: Isolation and Fractionation of Chloroplasts	
Week 10		
Mon-Nov-6	Exam #2	
Wed-Nov-8	Plant Development Overview: Embryo → Adult	Ch 16: 16.1 - 16.5
Thu-Nov-9	Lab #10: Developmental Changes During Seed Germination	
Week 11		
Mon-Nov-13	Hormones and development: Auxins	Ch 18: 18.1 - 18.11
Wed-Nov-15	Hormones and development: Gibberellins	Ch 19: 19.1 - 19.9
Thu-Nov-16	Lab #11: Prep day for bean initiation, root initiation, and pea stem growth labs Treat Tissue Culture	

Week 12		
Mon-Nov-20	Hormones and development: Cytokinins	Ch 20: 20.1 - 20.4
Wed-Nov-22	Hormones and development: Abscisic Acid, Ethylene, and Brassinosteroids	Ch 21: 21.1 - 21.3
Thu-Nov-23	NO LAB	
Week 13		
Mon-Nov-27	Orienting Plants in Space and Measuring Time	Ch 22: 22.1 - 22.7
Wed-Nov-29	Orienting Plants in Space and Measuring Time	Ch 23: 23.1 - 23.3
Thu-Nov-30	Lab #12: Bean Branch Initiation: Apply Auxin and Cytokinin Spray Pea Stems with GA Root initiation lab: Treat beans	
Week 14		
Mon-Dec-4	Exam #3	
Wed-Dec-6	Flowering and Fruit Development	Ch 25: 25.1 - 25.3
Thu-Dec-7	Lab #13: Bean Branch Initiation: Auxin data Seed Germination and Light	
Week 15		
Mon-Dec-11	Secondary Metabolites	Ch 27: 27.1 - 27.7
Wed-Dec-13	Secondary Metabolites	Review/Catch-up
Thu-Dec-14	Lab #14: Root initiation lab: Collect data Bean Branch Initiation: Auxin data Collect Pea Stem data	
Finals Week		
Wed-Dec-20	Cumulative Final - 10:15 - 12:15 (SCI A208)	