# PLB320: Plant Physiology

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Dept of Plant Biology phone: 453-3212

Office hours: MWF10am-11am, or by appointment LSII rm 403.

Lectures: Monday, Wednesday, Friday 11am - 12noon FANR 2204

Lab: Tuesday 1-3pm LSII 457

## **Textbooks required (2):**

**1:** *Plant Physiology and Development*, 6th ed., Taiz and Zeiger, 2015 ISBN:9781605352558

**2:** *Experiments in Plant Physiology.* Reiss, 1994. ISBN:0137012853

## Websites:

<u>online.siu.edu</u> (Desire2Learn site) www.plantphys.net (Textbook ancillary site)

## **Course Goals and Objectives**

The modern plant physiologist is increasingly more diverse and more interdisciplinary, employing a variety of molecular, cellular, genomic, physics and mathematical tools to study questions at many different levels, ranging from the gross behavior of a whole plant to the chemical structure of a single molecule. This course will explore the biological and environmental topics relevant to the physiological processes of plants. Primary topics in this course will include the roles and importance of light, water, mineral nutrients, secondary compounds, and plant hormones in growth, development and reproduction of plants. The course will emphasize the importance of the individual processes to the breadth of the field now considered to be "plant physiology". The objectives of this course are to introduce students to and instill a basic understanding of:

- 1. The fundamental importance of water relations to plant growth, development, and function
- 2. The biochemical processes that comprise plant primary and secondary metabolism
- 3. The roles of various essential and beneficial plant mineral nutrients
- 4. The role of hormones and environmental factors in the control of plant growth and development
- 5. Important techniques used in plant physiology research
- 6. Dissemination and data mining of information in the modern scientific community

**On Lectures:** Science has its own language, and in reaching the 300 level many of the terms and concepts will become increasingly difficult and non-intuitive. A real danger as you transition from the basic to the advanced levels in science is falling behind. This course cannot be completed or studied for in the few days before the exam; that is a path to disaster. I recommend that you attend every lecture prepared, and ask questions and take notes. The act of writing things down improves memory. For an hour after every lecture, read your notes with a textbook open, and flesh them out. Quickly look at the grading scheme, there are many exams, reports and labs (18 total). This is deliberate. It helps to keep you studying throughout the semester. I would recommend and encourage the use of electronic devices to record the lectures. Don't fall behind.

**On the Lab:** Attendance in the laboratory sessions is mandatory. If you have an unexcused absence from a laboratory, you will not be able to turn in the subsequent homework assignment for that laboratory. If an absence from a laboratory session is excused, and the homework involves the analysis of data collected during the lab, the instructor may assign and alternate but equivalent homework assignment to the student who had an excused absence for that lab session. Appropriate laboratory attire should be worn while attending lab session. This includes shoes with closed toes and preferably long pants. Personal protection materials are provided in the lab when required for an experiment. Cell phones are to be turned off or set to vibrate during lecture and lab. Calls should ideally be taken only in the instructor should be notified ahead oftime that a student may need to step out during the lecture or lab.

**On plagiarism:** In the era of web information, cutting and pasting, and word processing it is very tempting and easy to plagiarize. This includes lifting whole paragraphs, or even a single sentence. Plagiarism inhibits learning. You need to be able to express your own thoughts and ideas in writing, which is part of the educational experience at SIUC and in this course. Your answers on the labs, question sheets and exams must be your own, and may be subject to electronic comparison to other work. If you have difficulty writing, please visit me at office hours or after class for additional help.

**Readings assignment:** One of your semester long assignments is to keep up with scientific news. I have selected several articles from this year's issues of the three top scientific journals (*Science, Nature* and *Cell*). These will be introduced in class, and put on D2L. 1-2 questions in each of your exams will pertain to these articles.

**Literature search assignment:** Your first Lab report is a literature search. In the beginning of the semester, each of you will be given a paper copy of the scientific journal *Plant Physiology* published in 2001-2002. You must select an article from that journal, and distill from it one of the pertinent questions asked and answered in the paper. You will examine the history of that question by looking at the introduction and references. Then you will look into the future using the web of science and the <a href="http://www.plantphysiol.org/">http://www.plantphysiol.org/</a> website to see what follow-up work has been done in the 13-14 years since the publication of the article, and see how/if our understanding has changed regarding that question. This exercise gives you both an appreciation of mechanisms underlying scientific inquiry, the connectedness and synergy of the scientific community, and how to navigate the interconnections within scientific articles forwards and backwards through time through citations.

**Exams:** The course will include 3 midterms and 1 final examination. If you have a scheduling conflict and cannot attend an examination you must give written notice to the course instructor 10 days prior to the exam date for review. Make up examinations are subject to university policy and the instructors discretion. Emergency absence is also subject to university rules, please contact your instructor as soon as possible if an emergency occurs which will result in absence from an exam.

#### Grading:

Finals grades for this course will be based on a total of 500 points, with the allocation below.

Lecture exams 400 pts (4 @ 100 pts each)	A 720-800 pts
Question sets 200 pts (4 @ 50 pts each)	B 640-719 pts
Lab homework 100 pts (5 @ 20 pts each)	C 560-639 pts
Lab reports 100 pts (5 @ 20 pts each)	D 480-559 pts
	F <480 pts

Grades will not be subject to test score adjustments (curved), you are tested against the material, not fellow students.

Introduction, pathways for inter-plant interaction Review of basic botany and anatomy Review of genetics and genomics Plant Cells and Water Plant Cells and Water Plant water physiology Plant water physiology Photosynthesis physics Photosynthesis physics First Midterm Exam on Lectures 1-9 Photosynthesis chemistry Photosynthesis chemistry Plant circulation: movement of fluids through the phloem Plant circulation: Source-Sink relationship	Lecture notes Chapter 1 Chapter 2 Chapter 3 Chapter 3 Chapter 4 Chapter 4 Chapter 7 Chapter 7 Chapter 8 Chapter 8 Chapter 11
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Plant respiration: Chemistry	Chapter 12
Plant respiration: Genes and the mitochondrial genome	Chapter 12
Metabolic nathways: Primary metabolism	Chapter 12
Metabolic pathways: Primary metabolism	On KEGG
Metabolic pathways: Secondary metabolism	On KEGG
Second Midterm Exam on lectures 10-18	
Mineral nutrition	Chapter 5
Mineral nutrition	Chapter 5
Solute transport mechanisms	Chapter 6
Solute transport proteins	Chapter 6
Nutriont assimilation: Nitrogen	Chapter 13
Nutrient assimilation: Sulfur and Decemberia	Chapter 13
Coll well structure and expansing	Chapter 14
Coll wall chamietry: SySy, LICDago, CoS, CoZy	Chapter 14
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Signaling pathways: Wap Kinases	Chapter 15 Chapter 15
Third Midterm Even on least and 10.29	Chapter 15
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Signaling photoreceptors: Phytochrome and	Chapter 10
Cryptochrome	Chapter 17
Embryogenesis and early signaling for body	Chapter 17
organization	Character 17
Gene networks regulating organization of the meristems	Chapter 17
Abscissic acid, GA and seed dormancy	Chapter 18
ropisms and Auxin	Chapter 18
Vascular tissue differentiation	Chapter 18
Circadian rhythm and flowering	Chapter 20
Ethylene, SA, JA in defense against pathogens	Chapter 23
Ethylene, SA, JA in defense against pathogens	Chapter 23
ABA, ROS, and gene regulons in drought and cold	Chapter 24
stress	
stress ABA, ROS, and gene regulons in drought and cold	Chapter 24
stress ABA, ROS, and gene regulons in drought and cold stress	Chapter 24
	Solute transport mechanisms Solute transport proteins Nutrient assimilation: Nitrogen Nutrient assimilation: Sulfur and Phosphorus Cell wall structure and expansins Cell wall chemistry: SySy, UGPase, CeS, CaZy Signaling pathways: Map Kinases Signaling pathways: Hormone communication Third Midterm Exam on lectures 19-28 Signaling photoreceptors: Phytochrome and Cryptochrome Embryogenesis and early signaling for body organization Gene networks regulating organization of the meristems Abscissic acid, GA and seed dormancy Tropisms and Auxin Vascular tissue differentiation Circadian rhythm and flowering Ethylene, SA, JA in defense against pathogens Ethylene, SA, JA in defense against pathogens ABA, ROS, and gene regulons in drought and cold stress

# Lectures PLB320

**Office hours:** Thursday 10-12am **Office:** LSII room 427

Week	Topic	Reiss Lab Number	note
1	Basic spectrophotometry	1, appendix C	HW
2	Cellular water relations	9 part I, 10	
3	Cellular water relations	9 part I, 10	RE
4	Photosynthesis	3 part I and II	
5	Photosynthesis	3 part I and II	RE
6	Metabolism	2	HW
7	Metabolism	13 part II	HW
8	No lab (Fall Break)		
9	Ions and Guard cell movement	11	
10	Ions and Guard cell movement	11	RE
11	Hormones	17	RE
12	Hormones	28, 29	
13	Hormones	28, 29	RE
14	Hormones	27	
15	Hormones	27	HW
16	No lab		

# Laboratory schedule PLB320

# Note: HW = homework, RE = Report

<u>Emergency Procedures</u>. Southern Illinois University Carbondale is committed to providing a safe and healthy environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with the SIUC Emergency Response Plan and Building Emergency Response Team (BERT) program. Emergency response information is available on posters in buildings on campus, available on BERT's website at <u>www.bert.siu.edu</u>, Department of Safety's website <u>www.dps.siu.edu</u> (disaster drop down) and in Emergency Response Guideline pamphlet. Know how to respond to each type of emergency.

Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency. The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.