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The purpose of this course is to familiarize you with the existing body of knowledge in plant physiology (facts, theories, models etc.) and with the process of obtaining knowledge that is used by plant physiologists (experimental techniques etc.). The course requires an understanding of introductory biology (from BI 163/164) and some knowledge of basic chemistry (from CH 141/142 or a good high school course).

COURSE REQUIREMENTS

Readings - assignments from the textbook (Plant Physiology by Taiz and Zeiger, 4th edition) should be read before the corresponding class period. In addition to readings from the textbook, a few articles from the scientific literature will be assigned throughout the semester.

Class sessions – Tuesdays and Thursdays at 9:30 - Class periods will consist of lecture and discussion roughly following the schedule shown on page 4. For the exams you will be responsible for all material covered in class. If you miss a class period, be sure to find out what we covered by getting notes from another student.

Labs - Thursday at 1:00 - The length of the lab period will depend on how long it takes to finish each experiment and we may not always be able to finish by 4:00. You are expected to keep a well-organized lab notebook while doing the lab experiments. Further information about how to keep your lab notebook may be found on page 6.

Exams - There will be two exams during the semester and one final exam during exam week.

Exam I - Tuesday 9 Oct

Exam II - Tuesday 13 Nov

Final Exam - (exam period #5)

This will be a comprehensive exam over all material covered during the semester.

This is a closed book exam - no books or notes may be used.

Material available on the course web site – The syllabus, laboratory handouts, problem sets and other important materials for this course will be available electronically from the BI214 web site. Please be sure that you access the necessary documents and print them out by the time that you need them.

http://www.colby.edu/academics_cs/courses/BI214/index.cfm

Papers - You will be responsible for turning in two laboratory research papers during the semester. Requirements for these papers are described in detail on page 5.

First paper - due 30 October at 9:30 am. This paper should describe one of the first three lab projects that you did (mineral nutrition, water potential, or leaf pigments)

Second paper - due 4 December at 9:30 am. This paper should describe either your amylase assays or your experiments on stomatal aperture.

Lab notebook - Your lab notebook should include a complete, well organized, and legible record of the work that you did in the lab. Requirements for the lab notebook are described in detail on page 6. Lab notebooks will be collected after the completion of each laboratory project.

ATTENDANCE

You are expected to attend all classes and labs as we will be doing something important every day. If illness or other extenuating circumstances cause you to be absent you will be responsible for making up the work missed.

OFFICE HOURS

A schedule is posted outside of my door indicating what times I am teaching classes and labs. I am usually in my office at other times and I strongly encourage you to stop in and visit me. I will designate more specific office hours once the semester is underway. Please come and talk to me if you have any questions regarding the material in this course or any issue of concern to you.

GRADING

Exam I	100 pts
Exam II	100 pts
First Paper	70 pts
Second Paper	70 pts
Final Exam	200 pts
Lab notebook	<u>60 pts</u>
	600 pts total

Grades will be based on the % of the total points available. Other less quantifiable factors such as class participation, laboratory performance etc. may also be taken into account, especially in the case of students whose final percentages fall on the borderline between two letter grades.

94 - 100	A
90 - 93	A-
87 - 89	B+
83 - 86	B
80 - 82	B-
77 - 79	C+
73 - 76	C
70 - 72	C-
67 - 69	D+
63 - 66	D
60 - 62	D-
≤ 59	F

Plagiarism, cheating, and other forms of academic dishonesty are serious offences. The instructor may dismiss the offender from the course with a mark of F and will report the case to the department chair and the dean of students, who may impose other or additional penalties including suspension or expulsion. (Colby College Catalog)

SCHEDULE

<u>DATE</u>	<u>CLASS</u>	<u>LAB</u>	<u>READING</u>
SEPT 06 R	introduction	intro	.
11 T	plants and their cells		chapter 1
13 R	bioenergetics/redox	mineral nutrition	chapter 2*
18 T	properties of water		chapter 3
20 R	water potential	measuring Ψ	chapter 3
25 T	water movement		chapter 4
27 R	minerals	measuring Ψ	chapter 5
OCT 02 T	mineral nutrition		chapter 5 McNeill [♦]
04 R	enzymes	leaf pigments	chapter 2*
09 T	EXAM		
11 R	mineral uptake /membranes	amylase assay	chapter 6
16 T	guard cells		Liu [♥]
18 R	leaves, light, and pigments	stomata	chapter 7
23 T	FALL BREAK		
25 R	photosynthesis	stomata	chapter 7
30 T	photosynthesis (paper #1 due)		chapter 8
NOV 01 R	photorespiration/C4	stomata	chapter 8
06 T	carbon metabolism		chapter 8 Stafford [®]
08 R	whole plant photosynthesis	photosynthesis	chapter 9 Kebeish [▲]
13 T	EXAM		
15 R	phloem transport	photosynthesis	chapter 10
20 T	phloem loading		chapter 10
22 R	THANKSGIVING BREAK		
27 T	respiration		chapter 11
29 R	N fixation	photosynthesis	chapter 12
DEC 04 T	N assimilation (paper #2 due)		chapter 12
06 R	defense compounds	presentations	chapter 13 Sinha [▲]

*Chapter 2 is available from the course web site

[♦]McNeill JR and Winiwarter V (2004) Breaking the sod: humankind and history. Science 304:1627-1629

[♥]Liu X et al (2007) A G protein-coupled receptor is a plasma membrane receptor for the plant hormone abscisic acid. Science 315:1712-1716

[®]Stafford, N (2007) The other greenhouse effect. Nature 448:526-528

[▲]Kebeish R et al (2007) Chloroplast photorespiratory bypass increases photosynthesis and biomass production in *Arabidopsis thaliana*. Nature Biotechnology 25:593-599

[▲]Sinha G (2007) GM technology develops in the developing world. Science 315:182-183

LAB SCHEDULE**PLANT PHYSIOLOGY****BI 214**

SEPT	06	introduction sunflower seedlings, potato tubers
	13	mineral nutrition
	20	measuring Ψ (measurement of Ψ)
	27	measuring Ψ (measurement of Ψ_s) mineral nutrition-measure plants
OCT	04	leaf pigments
	11	amylase assay mineral nutrition - measure plants
	18	stomata (basic experiments)
	25	stomata (your own experiments)
NOV	01	stomata (your own experiments)
	08	photosynthesis (basic experiments)
	15	photosynthesis (your own experiments)
	29	photosynthesis (your own experiments)
DEC	06	presentations

PAPERS

Your papers are to be written in a format similar to that used for papers that are submitted to the journal *Plant Physiology*. We will use a somewhat abbreviated and modified version since your papers will probably be shorter than most *Plant Physiology* papers. Your manuscripts should be typed, double-spaced, and printed on either one or both sides of 21.5 x 28 cm paper.

TITLE PAGE - (p1) Title of article, author's name

ABSTRACT - (p2) a summary of the work you did, the results obtained, and the significance of those results (100 - 150 words). It is best to write the manuscript first and then the abstract so you will know what it is you are summarizing.

INTRODUCTION - This should be about one page long and should give the reader a bit of background about the subject under study and the relevance of the experiment(s) you did.

MATERIALS AND METHODS - Here you should briefly describe the experimental techniques that you used and how you obtained any important (or unusual) materials. The purpose of this section is to allow another scientist to be able to repeat your experiments if there are any doubts about the results. You can divide this section into subsections with subheadings if necessary. In order to avoid including an excessive amount of boring detail in this section you may want to refer to existing descriptions in the literature. For example, you might want to write something like "RNA was prepared from *Arabidopsis* seeds using the method of Jones et al (1994) except that the solutions were incubated at 40° for 20 minutes instead of 10 minutes".
(about 1-2 pages depending on the complexity of the methods used)

RESULTS - In this section you will describe the results you obtained in your experiments. This will generally require the use of at least two figures (see below) and some text describing what conclusions can be drawn from them. This section should usually be divided into subsections with subheadings. (about 1-2 pages depending on the complexity and amount of data)

DISCUSSION - Here you should discuss the significance of your results in a broader sense. Do your results agree or disagree with previous work (if any) that has been done? Are there any doubts about the reliability of your results that the reader should be cautioned about? Are there any further avenues of study that are suggested by the results you obtained? (about 1 page)

LITERATURE CITED - Here you should list any references that you referred to in your paper. Your references may be books, journal articles, book chapters, theses etc. You must use at least one journal article from the Colby library (in addition to any articles you use from the Col. J. Res. Meth.) in the preparation of your paper. Look at a recent issue of *Plant Physiology* in the library for the appropriate reference format.

FIGURES - You should generate good quality, easy to understand figures that will communicate to the reader the results you have obtained. These can be line graphs, bar graphs, drawings etc. Use whatever is most appropriate for the type of data you have. You may use programs such as Excel or Powerpoint to generate figures. Each figure should be numbered (Figure 1, Figure 2, etc.) and should be accompanied by a brief legend explaining what type of experiment the results

are from and defining any symbols used. You may either include each figure (with its legend) at the point in the text where it is first referred to or you may put all of the figures at the end of the document.

NOTE: Although you will have carried out your experiments together with your lab partner, each paper must be an individual effort. You certainly may discuss the results of your experiments with your partner or with anyone else, but all of the writing in your paper must be your own individual work.

LAB NOTEBOOK

Your lab notebook should be a complete, well-organized, and legible record of the work you have done. Keep your lab notes in a bound notebook, and write all of your entries in pen. Your notebook should be divided into 9 sections, one for each of the lab exercises.

<u>LAB WRITE-UP</u>	<u>POINTS ALLOTTED FOR GRADING</u>
#1 mineral nutrition	8
#2 water potential (Ψ)	4
#3 water potential (Ψ_s)	4
#4 leaf pigments	5
#5 amylase assay	5
#6 stomata (BE)	4
#7 stomata (YOE)	8
#8 photosynthesis (BE)	4
#9 photosynthesis (YOE)	8
(photosynthesis presentation)	<u>10</u>
	60 total

Each of your nine sections should include:

TITLE

OBJECTIVES - Include at least a couple of paragraphs explaining what you are going to do and describing the biological significance of your experiment.

PROCEDURES - It is OK to just refer to the lab handout here if you followed a procedure that is clearly spelled out in the handout. Make sure to record any deviations from the established procedure and any procedures you used that are not described in the handout.

OBSERVATIONS - Write down everything of significance that happens during your experiment. Make your observations immediately while the experiment is in progress. Don't wait until later or you will forget. Don't just record the data but also include any notable observations you made. Calculations made from your data and graphs of your data can go at the end of this section.

INTERPRETATIONS - What conclusions can be reached from your results? What does it all mean? Why did you observe what you did?

Sections that are italicized in the lab handouts indicate items that **MUST** be included in the lab write-up. This does not mean that these are the only things that should be included.

Your completed lab notebook will be turned in after completion of each of the nine sections. The notebook is due at 5 PM on Friday on the weeks that it needs to be turned in.