

HORT 301 Research Project:

Nov. 9th to Dec. 7th

Summary of Independent Research:

Teaching Plant Physiology requires both lectures and laboratory classes. Because plants affect so many aspects of our lives it is essential to understand the processes that govern this kingdom of life. We have nine structured laboratories in HORT301 that cover key aspects of plant physiology. All of these are designed to be short-term projects intensely focusing on fundamental principles. The last five weeks of the course are designed to allow you to explore a principle of plant physiology that we haven't covered in the previous nine labs. This gives you the unique opportunity to explore a topic that is of particular interest to you. The instructors and TA will prepare a list of possible projects. Each student will be expected to go through and read the brief paragraph explanations of these projects. Afterwards, the students will choose a topic/project that is of particular interest to them. The first assignment will be to conduct literature research in order to learn more about the principle of plant physiology the project focuses on. The TAs and experiment instructors will form groups based on similar interests and sit down with each group to design a set of experiments to test a hypothesis or demonstrate a principle. Over the course of the following weeks, the groups will conduct research on their own, but with help and periodically reporting in to their TAs and instructors. Students will have the opportunity to use techniques and principles learned in the first eight labs to address the Independent Project as well as learn new ones in the process. Overall, the Independent Project is a guided group project allowing students to explore elements of plant physiology that are of particular interest to them while learning new laboratory techniques as well as expanding on previous covered material. At the end of the Independent Projects students will be responsible for a short and concise oral report in class. This report will be given as a group presentation. The project will conclude with a detailed written report giving each student individually the opportunity to write a formal scientific write-up. These write-ups are individual reports that must not be copied from each other. Each student has to turn in her/his own report on the group project.

Your assignment is to design and perform an experiment that will further our understanding of plant physiology.

For the independent project you will work in groups on a research project of your own choosing. You will have freedom to choose your project and how you approach the scientific question presented. The Teaching assistants will work with you on each step in order to familiarize you with independent research and the aspects of an experimental project.

- The Teachings Assistants and Instructors will prepare a list of experimental projects that will be available for the independent research section of the laboratory. These projects will be assigned based on interest in project, background research done, and laboratory capabilities.
- You have access to any equipment that you have used in HORT 301 labs to date. Other

instrumentation could be made available, depending on your experimental objectives. A wide range of environmental growth conditions could be provided. Your TAs may also be able to get you access to other equipment in laboratories around campus.

Make a rational case for a line of inquiry that does not exactly fit these suggestions. Convince your instructors that it has merit, and we'll try to facilitate the experiment.

Note: You will have much flexibility in the way you structure your experiments. You may choose to design two experiments that follow each other sequentially. The design of your second experiment may be informed by the results of the first experiment, for example. Or you may choose to carefully plan and carry out a single experiment that extends throughout the period until Dec. 4th. Careful formulation of the hypothesis and detailed planning of a single experiment will likely be more productive than doing two poorly-planned experiments.

You need to determine what treatments you will subject the plants to and what physiological or metabolic parameters you will measure to assess the effects of the treatment. Your group must have decided on your experiment(s) by the end of class on Nov. 9th. ***We must have an outline of your experiment and a list of the equipment and materials you will need before November 16th, however in most cases it is advised to have everything ready to go by the end of lab on the 9th!!!***

A Few Guidelines and Hints:

1. Choose and sign up early for your project choice. This way you have enough time to discuss your choice with the instructors and you will be better able to find out what the project requires. Use the period until Nov. 9 to do literature searches and develop an understanding of the role of the process you are basing your hypothesis on. The extent of your preparation at this stage will be critical to the success of your project. You are expected to review the literature and come well prepared to discuss your hypotheses and experimental plans on Nov. 9. If you do not show evidence of preliminary planning, you will not be permitted to proceed with the project. See the suggestions below for effective searching of relevant literature.
2. Your experimental treatments can start as early as the afternoon/evening of the 9th and run until your lab period ends before Dec. 4th.
3. Visual observations and simple data collection can be carried out during scheduled lab periods or at other times. Please make arrangements with The TAs or the instructors if it is necessary to treat your plants or collect data at other times. Some pieces of lab equipment will only be available during Monday labs.
4. All of the TAs and instructors will be available during your teams' discussion and will be able to advise you on how to effectively apply your treatments.
5. Start with a clearly stated hypothesis, and build your experiments from there. The role of ascorbate is likely to be complex and not easily dissected, so don't jump to an experimental

plan without care and adequate reflection. **The careful formulation of your hypothesis is undoubtedly the most important step in this project.** Remember that the one quality of a good hypothesis is that it can be rejected or falsified by experimental evidence. It is not a vague or overly general statement of what you expect to find. Rather, it should be very tightly focused to ask a specific question about how ascorbate functions.

6. Give careful attention to the number of replicates per treatment (there should be at least three). Focus your experiment. Don't make your experiment overly complex and difficult to carry out by adding too many treatments.

Research Report of the Independent Project

The grade for this project is comprised of three parts:

15 pts	Preparation of background material on your topic/hypothesis	(Due November 9 th)
70 pts	Written report	(Due December 11 th)
50 pts	Group oral report	(given on December 7 th)
15 pts	Participation in discussion	(on December 7 th)
150 pts	Total	

Written Report: (70 pts)

After the design of the experiment, the collection and analysis of data, and the formation of a conclusion, the writing of the laboratory report completes the experiment. Each student will prepare their own typed laboratory report to be handed in at the beginning of class December 6th. The report should follow the format of a journal article. The grading key for the report is given below.

Title (4 pts)

Declarative statement of findings

Introduction (10 pts)

Brief subject background
Indicate relevance of research
State hypothesis

Materials and Methods (15 pts)

This section must include enough information about how the experiment was carried out to enable another scientist to repeat your experiment. Provide information regarding:

Growing conditions (lighting, temperature, photoperiod, irrigation frequency, etc.)
plants (species, age, quantity)
experimental design (# of replications and treatment groups)
treatment (concentration, method of application, number of applications, etc.)
details of data collection (equipment used, how samples were prepared, how measurements were taken)

Results (15 pts)

This section should include a written description of your observations and the responses you measured (identify trends and indicate statistical significance). Figures should be clearly labeled, and a figure caption should state the main point(s) of the figure.

Discussion (20 pts)

Include:

What are your conclusions (what response did you observe and was it due to the treatment?)

What implications do your results have for future research on this subject?

Are any practical applications suggested by your results?

Are follow-up experiments needed? Could alternative approaches be used?

What could be done next?

References (6 pts)

In addition to course handouts or Taiz & Zeiger, you must include at least two references from peer-reviewed journals. These are professional journals where manuscripts are reviewed by the experts on that subject and are critically evaluated for their merit to ensure (hopefully) that the results are valid. If you use web resources, databases etc., then cite these also accordingly. It is not permitted to use material from uncited sources in your written report!

Group Oral Report: (50 pts)

Each research team will present their results to the other teams in a 20 minute presentation on December 6th. 15 minutes will be for the presentation and 5 minutes will be allowed for questions from members of the other research groups. Your presentation should include a brief introduction which clearly states the problem and hypothesis of the team. Results should be presented in graphs or figures, and the conclusions of the team should be presented. Areas of future study should also be addressed. A laptop will be provided for PowerPoint presentations.

Overall presentation (15 pts)

- Had clear, organized format
- Spoke clearly
- Demonstrated confidence and familiarity with results and subject
- Expressed enthusiasm and interest in project

Title and Introduction (10 pts)

- Title was a declarative statement summarizing the hypothesis
- Clearly identified hypothesis
- Briefly explained rationale for hypothesis

Results (10 pts)

- Graphs and figures displayed key points of project
- Showed only one important idea per graph
- Legends and text were visible
- Identified trends in data
- Used statistics to interpret data trends

Discussion (15 pts)

- Demonstrated a clear recollection of the results obtained
- Demonstrated careful consideration of the significance of results
- Identified possible improvements for future investigation

Individual participation (15 pts)

- Actively engaged in responding to questions posed to the group, as well as asking questions and contributing to the discussion of results and conclusions from other groups

Some tips on searching for journal articles:

www.lib.purdue.edu/eresources/

follow the “All Databases by Title” link;
select links to the following (user-friendly) databases including

- Agricola
- CAB Abstracts
- Current Contents
- Web of Science (recommended)

For example, in Current Contents:

Check the “reviews” box to search for review articles that summarize the current state of knowledge about a given subject. These are the best articles to start with, and they will help you understand the processes affected by your stress. Further, review articles cite references to many other papers published on the subject. Those papers, in turn, will provide details that may help you to formulate some of the methods and procedures of your experiments (e.g., treatments, concentrations, measurements which could help you to understand the role or action of ABA for example).

- Enter keywords
- Select “perform search”

Scan through the hits

View “Abstracts” or “Complete Reference” if link is available

Select box corresponding to the article that looks most promising

Display information on that article by selecting “display” at the bottom of the screen

To find out how to view this article:

- Go to the Purdue Libraries homepage
- Under ‘Catalogs’, select ‘Purdue Libraries Catalogs’
- begin search by journal title, author or keywords

for example:

- search for “Plant Physiology” after selecting “Search by: Journal Title”

- click on “Plant Physiology” then “Online Version”

- from here, you can search by author, title, keywords

Because Purdue holds an institutional subscription to this journal, it will be available electronically. Other journals may be available only in paper versions. Most journals of interest will probably be in the Life Sciences Library (Lilly Hall, third or fourth floor).

HORT 301
Experimental Plan – Independent Project

Group Members: _____; _____; _____; _____

Circle: 11:30 1:30 3:30

(1) Hypothesis:

(2) Treatments and Replications:

(3) What will you measure?

(4) What equipment will you need?

(5) Which growth facilities will you require for your experiments? (Greenhouse space with temperature, growth chambers)

(6) Special Instructions / Requests? (use back of sheet if needed)

		Nov. 9	<p>Introduction to independent research problem define the problem; search for and analyze appropriate literature</p> <p>ASSIGNMENT: Gather background material on your intended topic in the form of journal articles, textbook chapters, and review articles. This is an individual assignment (not group) and you will be graded on the breadth and depth of your research as well as your understanding of the topic. This is due November 9th and required for beginning a research project.</p> <p>Development of hypotheses; planning of experiments By the end of this lab, your instructors have to sign off on your experimental plan before you are able to begin your project.</p>
		Nov. 16	Group experiments
		Nov. 23	Continuation of group experiments
		Nov. 30	Continuation of group experiments
		Dec. 7	<p>Oral report of research project</p> <p>ASSIGNMENT: Oral report (prepared by and contributed to by all members of the group)</p>
		Dec. 11	INDIVIDUAL written report of research project (no copying from other members of the research team allowed)