

Biology 115: Introductory Plant Biology Laboratory

The University of Tennessee, Fall, 2016
2 credits: 1 credit lab, 1 credit discussion

Catalog Description: Laboratory work will analyze plant structure, morphology, and function, with an emphasis on methods for observation, identification, and data collection. The discussion will focus on agricultural priority areas of the future: sustainable bioenergy, climate change, food safety, and food security.

Satisfies General Education Requirement: (NS with lab) if taken with Biology 113 or 114.

Contact Hour Distribution: 1 hour discussion and one 2-hour lab.

Recommended Background: 113 or 114 or equivalent.

Lab/Discussion: One 2-hour lab and one 1-hour discussion per week
Lab 1- Tuesdays 12:20-3:20, Lab 2- Tuesdays 3:35-6:35
204 Hesler Biology Building

Instructor/Coordinator: Dr. Benjamin Crain
F207 Walters Life Sciences
bcrain3@utk.edu
Office Hours: Tuesday 9:00-10:00am

Lab/Discussion Instructor: Morgan Roche
Austin Peay 401E
mroche2@vols.utk.edu
Office Hours: Wednesday 10:00-11:00am

People to Know: Jeff Martin- Greenhouse Manager
130 Hesler Building
Dr. Jessica Budke- Herbarium Director
316 Hesler Building

Course Learning Objectives:

By the end of the course, you should demonstrate proficiency in the following:

1. Investigate and describe basic plant structure, identification, function, evolution, and ecology
2. Demonstrate proficiency in the use of scientific equipment and methods to examine plants
3. Communicate scientific results
4. Explain how plants relate to the USDA priority areas of sustainable bioenergy, climate change, food safety, nutrition, and food security
5. Demonstrate basic proficiency in reading scientific literature related to plants

Support for Learning

Texts and Materials:

- *Biology 115 Laboratory Activity Instruction Packets*. To be provided by instructors electronically. Students must print. (Required)
- Evert, R., Eichhorn, S. (2013) *Raven Biology of Plants*. W. H. Freeman & Co., New York, NY, 727 pp. (Required)

- *Selected Publications* from primary peer reviewed journals emphasizing the field of Botany. To be provided by instructors electronically. Students must print. (Required)
- *Course Syllabus*. To be provided by instructors electronically. Students must print. Please place a copy of this syllabus in your lab notebook for reference throughout the semester. (Required)
- Laboratory Materials: Notebook & drawing pencils. Some students may wish to purchase personal materials for dissections: fine-pointed forceps, dissecting scissors/razors or bring digital cameras to take their own pictures of organisms. We will discuss the details of this the first day of class. (Strongly Recommended)

Course website:

<http://online.utk.edu/> (Blackboard).

Study Rooms:

417 Hesler is a quiet study room for majors in Biology. It can also be reserved for group study.

Communications:

- If you can't make office hours, please use your UTK e-mail (spam filters may exclude other addresses) to schedule a meeting.
- Please allow up to 48 hours for responses to your e-mails. E-mails will likely not be answered after the workday is over or on the weekends, so please be patient outside of normal work hours.

Class Policies

Policies MUST be followed at all times – no exceptions. Violation will result in a loss of points, or dismissal from the lab and/or course.

Lab Safety:

- There will be no food, drink or tobacco products used in the lab at any time.
- Personal items should be stowed away and not placed on the lab bench
- No open-toed shoes can be worn during lab. You will not be allowed to stay in the laboratory if you have improper shoes!

Lab Rules:

- You must clean and dispose of all laboratory materials as directed by your instructor before leaving lab. Leave the lab better looking than it did when you arrived.
- There will be no cell phone calls or texts in the lab at any time.
- Punctuality is a must. Interruption of the instructor and class members due to late arrivals is not acceptable. Lab/discussion lasts for 3-hours; you should expect to be there for the full three hours each week.

Lab Participation:

- Class attendance is mandatory – if you miss a class, you miss the points associated with that class. If you need to miss class due to a University-sponsored activity, you must notify your instructor at least 1 week prior to class, and they will try to make arrangements for you to “make up” the lab that week. Please note that this accommodation is only done for special circumstances. Even then, once the week is over, there is no way to make up a lab exercise.
- Prepare for the upcoming class prior to attending class each week – this includes reading the lab packets about the upcoming labs, as well as any assigned readings. Print out any required materials before coming to lab! The instructor will expect to see notes on the reading materials at the start of class.

- Assignments must be handed in in the manner requested and at the time requested by your lab instructor. This may include uploading it to SafeAssign. Any assignment turned in after the stated due date and time will be subject to a late penalty of 1 grade level per day late.
- Spelling, grammar, and formatting may be considered when grading.
- Exams and Quizzes will be given at the beginning of lab – if you are late and miss the quiz, you miss the points. There are no make-up quizzes without written notice from Physician, Fire Chief, Sheriff, Attorney, or President of the United States.

*Note that lab participation, i.e., coming prepared with materials, completed reading assignments with notes/questions for class, etc. may be effect your final grade!

Academic Matters:

- Academic dishonesty of any sort will not be tolerated. Students should refer to **Hilltopics** for University policies and procedures regarding these instances. You are expected to abide by The University of Tennessee honor statement in all of your university activities.

"An essential feature of The University of Tennessee is a commitment to maintaining an atmosphere of intellectual integrity and academic honesty. As a student of the University, I pledge that I will neither knowingly give nor receive any inappropriate assistance in academic work, thus affirming my own personal commitment to honor and integrity."

(Hilltopics, the UT Student Handbook)

- Copying sentences, portions of sentences, or re-phrasing sentences in the same order as another student’s will all be flagged as plagiarism by the University’s plagiarism software. You may discuss your labs with other students (this is encouraged), but write your lab work from your own thoughts. Your lab communications and presentations will be submitted through “SafeAssign” and plagiarism will not be tolerated.
- It is expected that all students attending lab will conduct themselves in a manner that is both respectful and accommodating to their laboratory instructors and to their working lab partners/fellow students. Rude and disruptive behavior cannot be tolerated and will result in the dismissal of the student from the lab period and possibly the course.

Grading Policies

Assessment of Learning (Point Earning Opportunities!)

Quizzes (5)	50 points
Written lab communications (3)	150 points
EOL Site and Presentation	50 points
Final Specimen Collection	50 points
Exams (2).....	200 points
	Total 500 points

-Note: Lab participation may also affect your final grade although it is not listed here.

-A maximum of 500 points can be earned. Extra points may be made available on quizzes, exams, and other assignments. This asterisk (*) indicates potential opportunities for earning extra credit for those who choose to do so (look for it in the syllabus, quizzes, and assignment handouts). Specific details should be discussed with your TA and the instructor.

Lab Quizzes (10 points each): The lab quizzes are given in order to keep you up to date on the material. They will occur during the first 30 minutes of a laboratory period. You must be in lab on time in order to take the quiz. Each quiz will have questions in a variety of formats. There may be “Show Me” questions where you will be asked to find a particular structure for your instructor; there will be a series of prepared slides and/or fresh material for you to choose from and if it is fresh material, you will have to make your own wet mount. When you have located the structure, raise your hand and your lab instructor will check to see if you have located the correct structure. You get two chances with the show me questions; full credit for getting it right the first time, half credit for getting it right on a second attempt. There may also be “Prepared Stations” where your lab instructor will set up materials in the laboratory for you to view and then answer a question regarding what you see. Lastly, there may be Short Answer questions. These questions will range in format from true/false, multiple choice, or short questions with one-word or one-sentence answers. A quick drawing with labels could also be requested. Note!: quizzes will cover material from the lab as well as from the assigned readings!

Written Lab Communications (50 points each): For three of the lab activities, you will need to prepare a written laboratory report that is similar in form to a primary publication. During these lab activities, you will work in small groups and prepare the final report as a team. The lab reports must follow standard publication structure that includes five principle parts: 1) Introduction, 2) Methods, 3) Results, 4) Discussion and Conclusions, and 5) References. You must include a succinct and alluring title and the names of each of your coauthors. You will not be required to prepare an abstract. Each report should be approximately 2 pages (not including title or references), double spaced, with 12 point Times New Roman font. Specific required details for each section are as follows:

Title & Authors (5 points): The headline or marquee for your project. It should be concise and enticing!

Introduction (10 points): What are you trying to do and why? Identify the issue and provide background premises of the problem. Provide rationale for the experiment itself-what are your aims? Present hypotheses and reasoning behind them.

Methods (10 points): What are you doing specifically? Describe how you will collect data and how you will test the hypothesis.

Results (10 points): What did you find? Describe the data itself here. Explain what data analysis tells you. Provide visualization of the data.

Discussion and Conclusions (10 points): What do the results tell you and what is your explanation for them? Was the hypothesis supported or rejected? What are the broader implications of your findings (consider your introductory arguments)? Describe the next steps in this line of research? Lastly, provide overall conclusions about your study.

References (5 points): You must provide references for your report. The formatting of the references is important, as it is unique for each journal. In this lab, we will use the following style:

- Article:
Last name, First initial., First initial. Last name, First initial, Last name. YEAR. Article title. *Journal Name* Issue #: Start page #-Ending page#.
Example:
Waterman, R., M. Bidartondo. 2008. Deception above, deception below: linking pollination and mycorrhizal biology of orchids. *Journal of Experimental Botany* 59: 1085-1096.
- Book:
Last name, First initial., First initial. Last name. YEAR. *Book Title*. Publisher Name. City, State (or country when applicable). Ending page # pp.
Example:
Darwin, C. 1888. *The Various Contrivances by Which Orchids are Fertilised by Insects*. J. Murray Publishers. London, England. 300 pp.

Exams (100 points each): Each lab exam is an expanded version of the quizzes and the same formats and contents will apply. The lab exams cover more material (the first half of the course and the second half of the course respectively) so there will be more questions on them.

EOL Site and Presentation (50 points): As part of this course, you and a group (4 students total) will be expected to contribute to, and present on, an Encyclopedia of Life (EOL) page dealing with one plant species (or algae, fungi, or member of any other group covered in class) of your choice (or a species can be assigned to you). Your group should preferably choose a species that can be considered interesting for any number of reasons; it could be invasive, edible, rare, culturally significant, or poisonous for examples. You must choose a species that lacks contributed information already (some sections may already be filled in, but there should be minimal or no information in the sections you will contribute to). Each group will be responsible for researching (using primary literature and/or collections) several aspects of the species of interest, including the following EOL “chapters”: 1) Diagnostic Description, 2) Distribution, 3) General Ecology, and 4) Significance (Conservation Status, Benefits, Risks, etc.). You must also include all references that you use on your site. For each chapter, one group member will prepare a 1-2 page document that will be loaded on EOL once reviewed. If appropriate, you may contribute to a different chapter with prior approval of your instructor. The goal of this exercise is to gain experience interpreting primary literature and data sources as well as with communicating scientific information to broad and diverse audiences. Your instructor will provide additional details in class, however the following grading scheme will be in place.

Diagnostic description (10 points): Here you will give a description of the plant itself. You can follow the descriptions used in the Guide to the Vascular Plants of Tennessee for style, but you should use information you collect directly from primary literature, herbarium specimens, and living examples from the Greenhouse, Botanical Garden, or the field to write your descriptions. Do not copy the descriptions from the guides, as you will not receive credit for this.

Distribution (10 points): This section is where you will discuss the distribution of you species. Consider its distribution in as many ways as you can. Is it limited to certain hemispheres, continents, or islands, for example? What are its elevation limits, if any? Is the species widespread or is it very rare? These are all characteristics of you species distribution that you may wish to consider including on your site.

Ecology (10 points): In this section, you will describe the fundamental ecology of the species. Think of how this species operates in its environment. Is it only found in wetlands? or perhaps on snowy mountain tops? What type of soils, temperatures, or moisture levels does it like? Use the resources you find in researching your species to decide what is most important about its ecology.

Significance (10 points): This section is for describing what is significant about your species of choice. You should consider one of the relevant categories (Conservation Status, Benefits, Risks, etc.) on EOL to complete this section. You have some freedom to choose what you wish to include in this section, but it should focus on one of the “chapters” that are listed on the site. Examples for this section could include discussions of the species’ uses, conservation issues and efforts related to the species, or evolutionary history of the species. It is recommended that you discuss this section with your TA and instructor.

Presentation (10 points): Towards the end of the semester, we will have a day for presenting the information on each site. Each group member will present their contribution and the audience will provide feedback.

References: You must provide references for your site. Follow formatting criteria as described in the Written Lab Communications section of this syllabus. Points will be deducted if sufficient references are not included.

You will initially turn in a written report to your instructor. Once it has been reviewed, the Information you gather for your species will be loaded on the EOL page (<http://eol.org/info/426>). For this activity, you will need to log in to the class EOL account: username is UTBot115 (<http://eol.org>), and follow the instructions for making a contribution (http://eol.org/info/writing_eol_chapters, http://eol.org/info/disc_contribute, <http://eol.org/info/254?#text>). Please discuss this with your instructor well beforehand; you will need the password to log in!

*There may be potential for earning extra credit by contributing additional information or your own personal photograph, so keep your eyes open in the field! Talk to your instructor first.

Herbarium Collections (50 points): As part of this course, you will be expected to make a collection of 5 herbarium specimens. Mounting paper for specimens will be provided to you. Plant presses and taxonomic keys are limited in supply so you must plan and coordinate with each other to make use of the necessary equipment while making it available to others when needed. Do not plan to check out a key or plant press-plan on using equipment on an as needed basis only, it will always be kept in the lab. Specimens are to be properly pressed, mounted, identified, and labeled. Each specimen will be worth a total of 10 points. To receive all points for this project the following criteria related to diversity and collection standards must be met:

Diversity (4 points each)- all collections must contain 1) a Bryophyte, 2) a Seedless Vascular Plant, 3) a Gymnosperm, 4) a Dicot (Angiosperm), 5) a Monocot (Angiosperm).

Collection Standards- All specimens must be properly pressed and mounted on herbarium paper. Specimens must also be properly labeled.

Mounting (3 points each) - 1) specimens should be properly prepared, pressed, and dried, 2) plant should be mounted properly, 3) specimen should be displayed properly (i.e., both leaf faces displayed, breaks and cuts obvious, 4) the entire plant (roots and shoots) should be present when applicable (herbaceous plants), 5) specimens must have reproductive organs.

Labelling (3 points each) - The label for each specimen should include 1) a standard heading, 2) the State and County of collection, 3) the phylum (and the family name* and species epithet* if possible), 4) geographic coordinates and elevation, 5) growth form and habit, 6) a brief habitat description, 7) the collectors name, 8) the collection number, 9) the date, 10) the name of the person(s) identifying the specimen.

Example Label:

HERBARIUM OF THE UNIVERSITY OF TENNESSEE
Plants of Tennessee
Union County

Cypripedium reginae Walter (Orchidaceae)
N 36°25'24.4", W 083°46'38.4", Elev. ≈ 100m
Herbaceous terrestrial
From limestone seep on west facing slope along Powell
River near Kelly Hollow
B. Crain #27, E. Schilling, D. Horn, J. Lampley, 5/26/2015
Det. B. Crain

Final Grades

Final letter grades will be determined by the total percentage of 500 points accumulated as follows:

A	93 – 100%	C	73 – 76%
A-	90 – 92%	C-	70 – 72%
B+	87 – 89%	D+	67 – 69%
B	83 – 86%	D	63 – 66%
B-	80 – 82%	D-	60 – 62%
C+	77 – 79%	F	<60%

Other Information

Disability Services: If you need course adaptations or accommodations because of a documented disability, please contact me privately to discuss your needs. If you have questions or concerns about disabilities or emergency information to share, please contact Disability Services: 100 Dunford Hall; 974-6807 or 865-622-6566 for video phone; Email: ods@utk.edu; Website: <http://ods.utk.edu/>).

Academic Assistance:

Tutoring: The Division of Biology does not offer tutoring services. Contact the Student Success Center and the Academic Support Unit of The Office of Minority Student Affairs for information about tutoring opportunities.

- Student Success Center: The comprehensive source for information, services, and resources to assist your success at UT: <http://studentsuccess.utk.edu>
 - 812 Volunteer Boulevard, Greve Hall, room 324
 - 865 974-6641, Email: studentsuccess@utk.edu

Technical Assistance:

Blackboard, clickers, or general information technology assistance:

- Help Desk: 865 974 9900 (M – F, 8:00 – 5:00)
- OIT Walk-In Help Desk: Commons, 2nd floor Hodges Library, 9am-9pm M-Th, 9am-5pm F, 4p-9p Su
- Turning Technologies (clickers): 866 746 3015

Counseling Center: <http://counselingcenter.utk.edu/>

1800 Volunteer Boulevard

865 974-2196, Email: counselingcenter@utk.edu

Other Resources for Students:

- One Stop: <http://onestop.utk.edu> (Hodges Library, Ground Floor, 8a-5p M-F)
- Undergraduate Catalogs: <http://catalog.utk.edu> (Listing of academic programs, courses, and policies)
- Hilltopics: <http://hilltopics.utk.edu> (Campus and academic policies, procedures and standards of conduct)
- Course Timetable: https://bannersb.utk.edu/kbanpr/bwckschd.p_disp_dyn_sched (Schedule of classes)
- Academic Planning: <http://www.utk.edu/advising> (Advising resources, course requirements, major guides)
- Library: <http://www.lib.utk.edu> (Access to library resources, databases, course reserves, and services)
- Center for Career Development: <http://career.utk.edu> (Career counseling and resources; HIRE-A-VOL job search system)

DEGREE LEVEL LEARNING OUTCOMES

Students seeking a degree in Biological Sciences (whether the concentration is in Biochemistry, Cellular, and Molecular Biology, Ecology and Evolutionary Biology, or Microbiology) are expected to be able to do the following by the time they graduate:

Explain and provide examples of each the five big ideas in Biology, using their knowledge of biological concepts gained from their course of study:

- **Evolution:** Populations of organisms and their cellular components have changed over time through both selective and non-selective evolutionary processes.
- **Structure and Function:** All living systems (organisms, ecosystems, etc.) are made of structural components whose arrangement determines the function of the systems.
- **Information Flow and Storage:** Information (DNA, for example) and signals are used and exchanged within and among organisms to direct their functioning.
- **Transformations of Energy and Matter:** All living things acquire, use, and release and cycle matter and energy for cellular/organismal functioning.
- **Systems:** Living systems are interconnected, and they interact and influence each other on multiple levels.

These biological concepts are more fully explained in the AAAS / NSF report "Vision and Change in Undergraduate Biology Education" (visionandchange.org)

Demonstrate the ability to perform the following scientific practices:

0. Formulate empirically-testable hypotheses
1. Interpret visual representations (figures and diagrams)
2. Evaluate data and come to a conclusion (with evidence) (formulate an argument)

-Student ability to achieve these learning objectives will be tested periodically as part of their departmental requirements.

Course Schedule

Week	Date	Lab/Discussion	Assignments	Reading	Due
0	Aug. 16	No Class, Classes begin Aug 17th	None	None	Nothing
1	Aug. 23	Introduction: Microscopy and Basic Anatomy (Plant, Fungi, and Algae Parts)	Lab Activity 1	Reading: Ch 1; p.336 Section 2 & Fig. 15-19a; pp.298 (second paragraph)-299; pp. 530-532 & Fig. 22-6; Figs. 22-10, 22-11, 22-12, 23-4, 25-8, 25-13	Lab Activity 1
2	Aug. 30	Plant Cell and Tissue Types: (Identifying Principle Plant Cells and Tissues)	Lab Activity 2	Reading: Chapter 23, ASPB 2013, (Raff 2013 not-required)	Lab Activity 2
3	Sept. 06	Greenhouse Visit (Living Collections, Variation in Plant Parts Types, Evolutionary Adaptations, Plant Function, and Plant Ecology)	Lab Activity 3 Project: Begin EOL Project Quiz 1	Reading: Chapter 24-pp. 572-576, Chapter 25-pp. 607 (last paragraph)-612; p. 239 Box 1; Williams et al. 2015, Chen et al. 2009 (not-required)	Lab Activity 3 Quiz 1
4	Sept. 13	Herbarium Visit (Mounting & Preserving Specimens, Methods for Plant Identification, and Evolutionary & Taxonomic Relationships)	Lab Activity 4 Project: Begin Herbarium Collections	Reading: Deng 2015; Lavoie 2013; Chapter 12; Figs. 25-17, 18, 19, 20,	Lab Activity 4
5	Sept. 20	Bacteria (Diversity and Antimicrobial Properties of Plants)	Lab Activity 5 Quiz 2	Sing Negi 2012; Chapter 13-pp. 256-270; Nazarro et al. 2013 (not required)	Lab Activity 5 Quiz 2
6	Sept. 27	Algae (Diversity and Harmful Blooms)	Lab Activity 6	Chapman 2013; Paerl et al. 2014; Liu et al. 2013; Chapter 15	Lab Activity 6
7	Oct. 4	Exam 1	Exam 1	None	Exam 1 Lab Report 1 (Bacteria Lab)
8	Oct. 11	Fungi (Diversity and Antifungal Properties of Edible Plants)	Lab Activity 7	Janzen 1977; Chapter 14	Lab Activity 7
9	Oct. 18	Non-vascular Plants (Significance as Bioindicators)	Lab Activity 8 Quiz 3	Schintu et al. 2005; Chapter 16; Carpi et al. 1994 (not required)	Lab Activity 8 Quiz 3 Lab Report 2 (Algae Lab)

10	Oct. 25	Seedless Vascular Plants (Ancient and Modern Fuel Sources)	Lab Activity 9	Marinelli 2003; Danielsen et al. 2009; Chapter 17; Brouwer et al. 2016 (not required)	Lab Activity 9
11	Nov. 1	Gymnosperms (Secondary Growth and Climate Change)	Lab Activity 10 Quiz 4	Grace et al. 2002; Chapter 18; Jump et al. 2006 (not required)	Lab Activity 10 Quiz 4
12	Nov. 8	Angiosperms (Flower Types & Pollinator Syndromes)	Lab Activity 11	Ollerton et al. 2009; Chapter 19	Lab Activity 11
13	Nov. 15	Angiosperms (Fruit Types and Food Sources)	Lab Activity 12 Quiz 5	Khoury et al. 2016; Chapter 20	Lab Activity 12 Quiz 5 Lab Report 3 (Gymnosperms)
14	Nov. 22	EOL Presentations	None	Jones et al. 2002	EOL Presentation, Herbarium Collections
15	Nov. 29	Exam 2	Exam 2	None	Exam 2

This schedule is tentative and subject to change!

*Aug 26 - Last day to drop without a "W"; Aug. 30 – Adjust hours for financial aid
Nov. 08 - Last Day to Drop with a "W" (WP/WF); Dec. 01 - Last Day for a University Withdrawal*